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BARTHOLDI'S GREAT STATUE OF "LIBERTY."—DRIVING THE FIRST RIVET.

ANOTHER step in the history of the colossal statue of Liberty presented by France to America is recorded in our illustration.

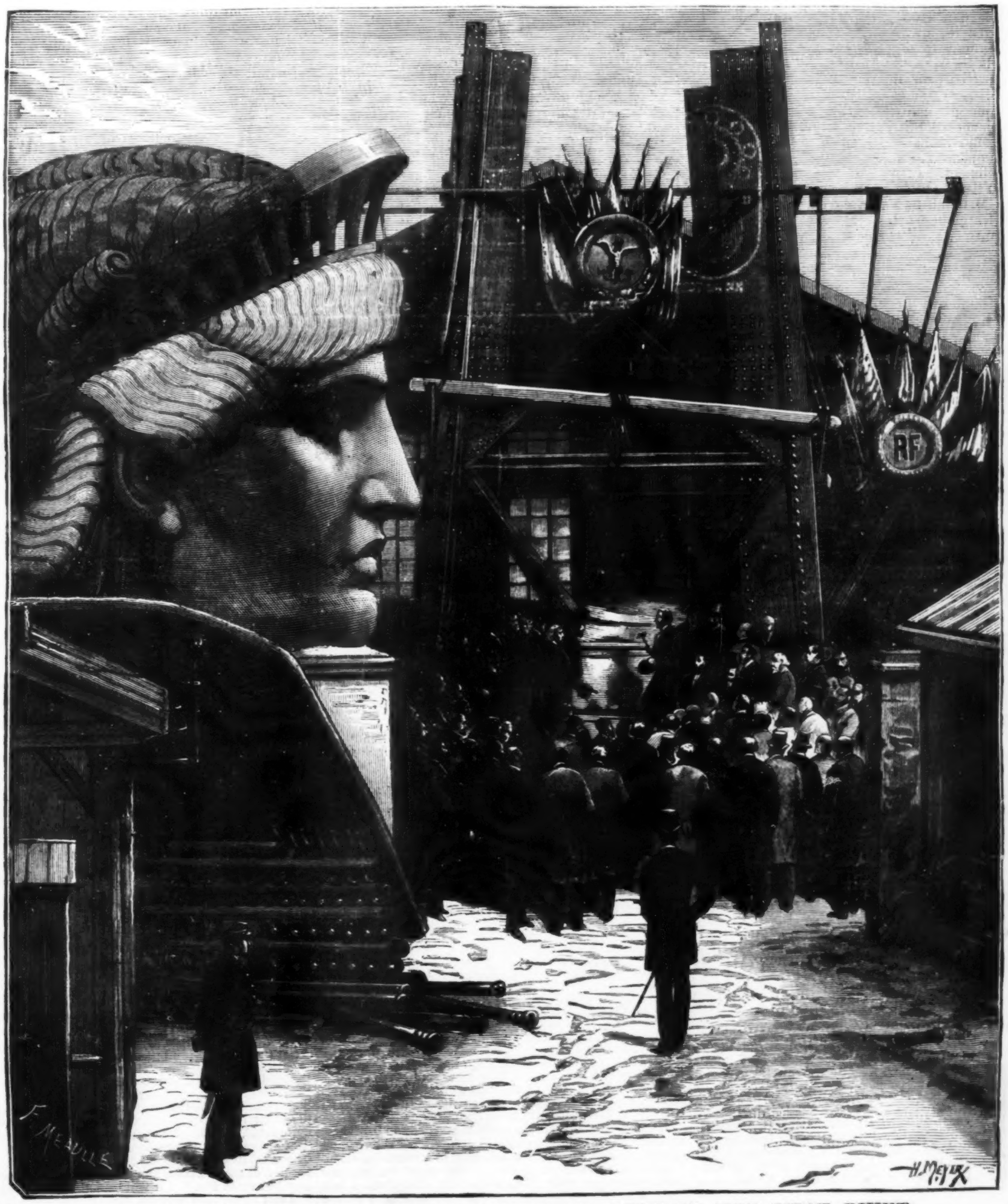
A little more than a year ago the completion of the popular subscription for this gigantic work was celebrated in Paris by a banquet, an account of which was given in the SCIENTIFIC AMERICAN, on July 24, 1880. Since that time the work of casting the bronze has been completed, and the first step in assembling the parts was signalized the other day by a public ceremony, part of which was the placing of the first rivet by the American Minister to France, Mr. Morton. The huge torch-bearing hand of the statue, it will be remembered, was exhibited at the Centennial Exhibition in Philadelphia, and since then has been standing on the Fifth Avenue side of Madison Square in this city.

The gigantic size of the statue is in some measure indicated by the hand, which so many of our readers have seen, and also by the relative size of the head and the human figures in our engraving. Still it is almost impossible to form an adequate idea of the imposing magnitude of the entire figure. The famous Colossus of Rhodes, the boldest achievement of ancient art, would appear but as a child beside it.

The intention is to set "Liberty Enlightening the World" on an appropriate site in New York harbor, Bedloe's Island being preferred as the most central. Facing the sea the statue will serve the double purpose of a light tower for the guidance of incoming ships, and a type of the grandeur of the New World in its physical features and its political institutions and influence. Bedloe's Island is small, yet ample for the intended purpose. It will furnish a base for the statue, perhaps twenty feet or so above the water. On this will rest the pedestal, 110 feet high. The statue, to the flame of the torch in the upraised right hand, is 145 feet high. This will raise the light at least 275 feet above the level of the bay, making it visible for many miles at sea.

The statue is cast in bronze, in pieces of manageable size, to be riveted together. For the engineering work of constructing the statue, a task requiring no mean skill, the sculptor has had the assistance of De Stückle.

Mr. Bartholdi is an Alsatian by birth, and has achieved an enviable fame as a sculptor, several of his works being of



BARTHOLDI'S GREAT STATUE OF "LIBERTY."—DRIVING THE FIRST RIVET.

gigantic size. After the Franco-German war he spent several months traveling in this country. Subsequently he was chosen by the French Government to prepare a suitable testimonial for the sympathy and diplomatic service rendered by the United States during the investment of Paris; and the result, a statue to Lafayette, now graces Union Square in this city. In 1876 Mr. Bartholdi was with us again as a commissioner to the Philadelphia Exhibition.

As an American undertaking, a colossal statue of this nature and for this purpose might seem unbecomingly ambitious, not to say bombastic; but as a gift from a friendly and appreciative republic across the sea its design and purpose cannot be misconstrued.

It is much to be hoped that when the statue is finished and presented there will be no unseemly delay in providing the site and the pedestal, for which subscriptions are now in order.

[Continued from SUPPLEMENT, No. 312, page 4973.]

AMATEUR MECHANICS.

METAL SPINNING.

THE operation of spinning metals, although exceedingly simple and capable of being practiced to advantage in almost every shop, and also by the amateur mechanic upon the foot lathe, is not generally understood. One reason for this is that the artisans who follow this branch of mechanics as a business usually conduct it under locked doors, and it is with considerable difficulty that the amateur in search of information on this and kindred subjects can obtain entrance to one of these establishments. The reason of this secrecy is plain enough, as the "kink" or "wrinkle," or, in plain English, the knowledge required to do the mechanical part of spinning, is so slight that secrecy is the only protection.

The tools required are few. They consist of a lathe; a form or mould on which to shape the article; a tool rest with a series of holes for receiving a pin to keep the tool from slipping, and a few spinning tools or burnishers of different sizes and shapes.

The lathe the amateur is supposed to possess; the tool rest he may easily make; and the only other addition to the lathe will be a back center of the form shown in Fig. 2. This form of center answers as a step to the work holder, and will bear considerable pressure without undue friction.

The tools required are shown in Figs. 3, 4, and 5. These are simply hard steel burnishers of the form shown, and varying in size with the size and kind of work to be done. The size given in the engraving is about right for amateur work on the foot lathe. Fig. 3 shows in two views a ball tool. Fig. 4 shows both side and edge views of a curved tool. Fig. 5 shows a plain round burnisher. In some instances it may be necessary to make tools of different forms. The operator will be guided in the selection of his tools by the particular work in hand, and practice will bring new suggestions as to tools and the manner of using them.

The materials generally used in spinning are brass, copper, zinc, britannia metal, and lead. All of these may be worked on the foot lathe, but perhaps the amateur will derive the most satisfaction at first by using britannia metal, as it works easily and does not require annealing. Articles in this metal also present a handsome appearance when done, whether simply polished or plated. Zinc must be spun quite hot. Articles of brass, if of considerable depth, must be annealed when partly done.

The form on which the metal is spun may be either hard or soft wood or metal. A good close-grained pine answers as well as anything for most purposes, and is very readily turned to the required form. It may be attached to the face plate, B, and the disk to be spun may be held against it at first by a hard wood or metal piece, C, as shown in Figs. 6 and 7, which is forced against the disk by the tail center. After the spinning is a little advanced, a cup-shaped holder is applied, as shown in dotted lines in Fig. 7. Sometimes the holder is secured by a bolt that runs through both it and the form or mould, as shown at D, Fig. 8. In some cases a little rosin is applied to the form to increase the friction, but this is rarely necessary. The motion of the lathe should be quite rapid, and the disk should receive a coating of grease (lard or heavy oil) before applying the burnisher. A very strong solution of soap may be used instead of oil. The position of the workman and the manner of holding the tool may be seen in Fig. 1. It will be noticed that the pin in the tool rest serves as a fulcrum for the tool, which must be brought with considerable pressure against the surface of

TOOLS FOR METAL SPINNING, AND EXAMPLES OF SPINNING

MOVING HOUSES BY FLOATS.

SOME time since the United States Government decided to abandon the barracks and quarters on Goat Island, in San Francisco bay, and all the property was removed. Lately it was found that new buildings were necessary at the Presidio, and the idea occurred to the officials to remove the Goat Island buildings to that place. The distance by water from the island to the Presidio is some five miles. The officers' quarters were separate, two story buildings, with verandas, etc. These were separately launched on to large scows, and then the scows with their topheavy freights were towed by the U. S. steamer General McPherson to the Presidio beach. Here the houses were disembarked by means of skids, and then drawn into position on the Presidio grounds. The larger buildings were removed in sections.

the disk. This pin is moved forward from time to time as the work advances. The movement of the tool may be seen in Figs. 9 and 10, and the shape taken by the metal in front of the tool will also be seen. In swinging the tool toward the form it is moved in the direction of the arrow as shown in Fig. 9, and it is carried back as shown in Fig. 10. This last operation is very essential to the proper fitting of the mould, and it also thickens the metal. Too much should not be attempted at a time. A succession of quick movements, as indicated in Figs. 9 and 10, under a moderate pressure is much better than to do a great deal of execution at a single stroke. Should the metal tend to vibrate or buckle, a piece of wood may be applied to the back with the left hand, as shown in Fig. 8.

The method of spinning a cup or pot without a form is illustrated in Fig. 11. Here the metal is supported by a plain cylindrical mandrel, and is first spun into the form indicated by the dotted lines, and then bringing the burnisher on the return stroke only to the shoulder which forms the larger part of the vessel. For small work on the foot lathe the handles of the tools need not be as long as represented in Fig. 1. The length commonly employed for wood turning tools will answer.

To spin a ring a mandrel like that shown in Fig. 12 will be required. A plain flat ring placed between the shoulders of the mandrel is pressed upon by the roller seen above the mandrel until the ring assumes the desired form. Napkin rings are made in this way. Fig. 13 shows a concave reflector. Fig. 14 represents a simple cup formed of two pieces. Fig. 15 represents a small vase made of three pieces, the smaller end of the upper or conical part and the upper portion of the base piece being soldered in a spherical connecting piece. The two halves of the ball, Fig. 16, are made upon the same form. The edges are beveled and soldered together. The pitcher, Fig. 17, is made of five spun pieces, a short cast and turned piece that unites it to its base, and a handle made of square wire. The card receiver, Fig. 18, has a spun top and base, and a cast standard. The vase, Fig. 19, consists of four spun pieces and three legs of square wire, uniting the body with the base. Fig. 20 shows a base for a magnetic needle or other small apparatus. Fig. 21 represents a vase composed of seven spun pieces and two handles of square wire. More complex examples of work done by the process of spinning might be furnished. The ones given are undoubtedly sufficient to enable the amateur to get an idea of the endless variety of articles that may be made by this simple and easily acquired art.

CHASING AND KNURLING.

Among the multitude of operations possible with a foot lathe perhaps none is more vexatious to the amateur than that of cutting a good screw thread, and no acquirement is more valuable than to be able to chase a screw thread easily and accurately.

The ordinary chaser, Fig. 1, is a simple tool which is easily made when one has the hubs for the different sizes; but wanting these, we recommend the purchase of chasers. A blank for an outside chaser is shown in Fig. 2, and the hub used in cutting the teeth is represented in Fig. 3. The latter consists of a piece of good steel having a thread of the desired pitch, which is traversed by spiral grooves to form cutting edges. This tool must have about the same temper as that of a tap. When used it is placed between the lathe centers and revolved at a slow speed, while the end of the chaser blank is held against it, being at the same time supported by the tool rest. The hub should be oiled during the cutting process. After cutting, the tool is hardened and tempered and ground on the elevated portion, which is the face, and smoothed on the back which slides upon the tool rest.

An inside chaser is shown in Fig. 4, the blank from which it is made in Fig. 5. For convenience in cutting the teeth, the blank is bent at right angles; after cutting and before hardening it is straightened.

The manner of starting a thread for chasing is shown in Fig. 6, the tool used in Fig. 7. The rest is placed a short distance from the work, the tool is held firmly upon it, and while the work revolves with a uniform speed the tool is moved dexterously so as to make a spiral line on the work, which is nearly, if not exactly, of the same pitch as the thread to be cut. If the operator is fortunate in the attempt, it will be a simple matter to start the chaser and move it along as indicated in Fig. 9. After a little practice it will in most cases be found an easy matter to chase threads without first starting them with a pointed tool. It is much easier to chase an inside thread than an outside one. A chaser seldom goes wrong when working on the inside.

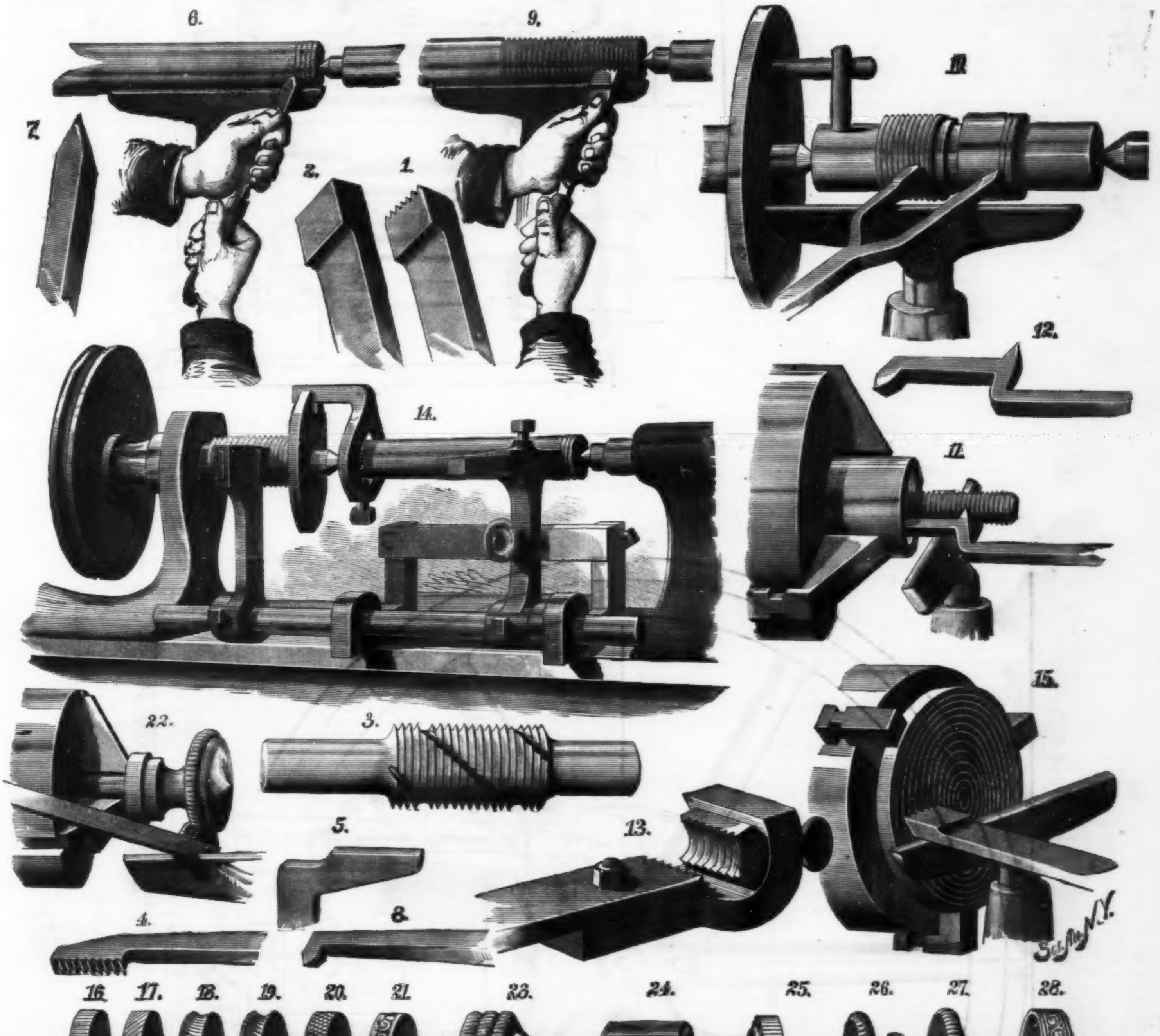
A method of chasing thimbles is shown in Fig. 10. The threaded thimble which forms the guide screw is driven on the larger end of the tapering mandrel; the thimble on which the thread is to be cut is placed on the smaller end of the mandrel. One arm of the forked tool has a vertical chisel edge which engages the guide screw; the other arm has a chasing point which cuts the thread. The chisel edge is first brought into engagement with the guide screw, the point is then quickly brought against the work with more or less pressure. After the thread is well started it may be finished with an ordinary chaser or with a pointed tool.

Fig. 11 shows a method of starting an inside thread. The chaser has a tracing edge that follows the guide screw projecting from the center of the chuck, and a cutting point that forms the thread. Fig. 12 shows the tool in detail.

Threads cut by a chaser without some kind of a guide to start them are often more or less crooked or drunken. To correct such threads and in cutting large threads, the doctor, shown in Fig. 13, is sometimes employed. The follower opposite the chaser is moved up by the thumbscrew as the thread deepens.

The most expensive, and at the same time the most desirable, contrivance for chasing screw threads is shown in Fig. 14. A casting fitted to the lathe bed has two ears, which are bored to receive the round sliding rod carrying the tool holder and the tracer. The tool holder is placed on the sliding rod between the two ears, and it carries a well-fitted screw, which bears against the horizontal bar supported by two square posts which form a part of the main casting. This bar forms a guide which may be adjusted within narrow limits by means of the screw seen in the right hand post.

The lathe is provided with a face plate having a long boss arranged to receive thimbles having leading threads of different pitches cut on them. The tracing arm carries a thin tracing which engages the threaded thimbles, and is capable of yielding to admit of moving the cutting tool forward against the object being threaded; but being well fitted



TOOLS FOR CHASING AND KNURLING.

THE RAVEL GAS MOTOR.

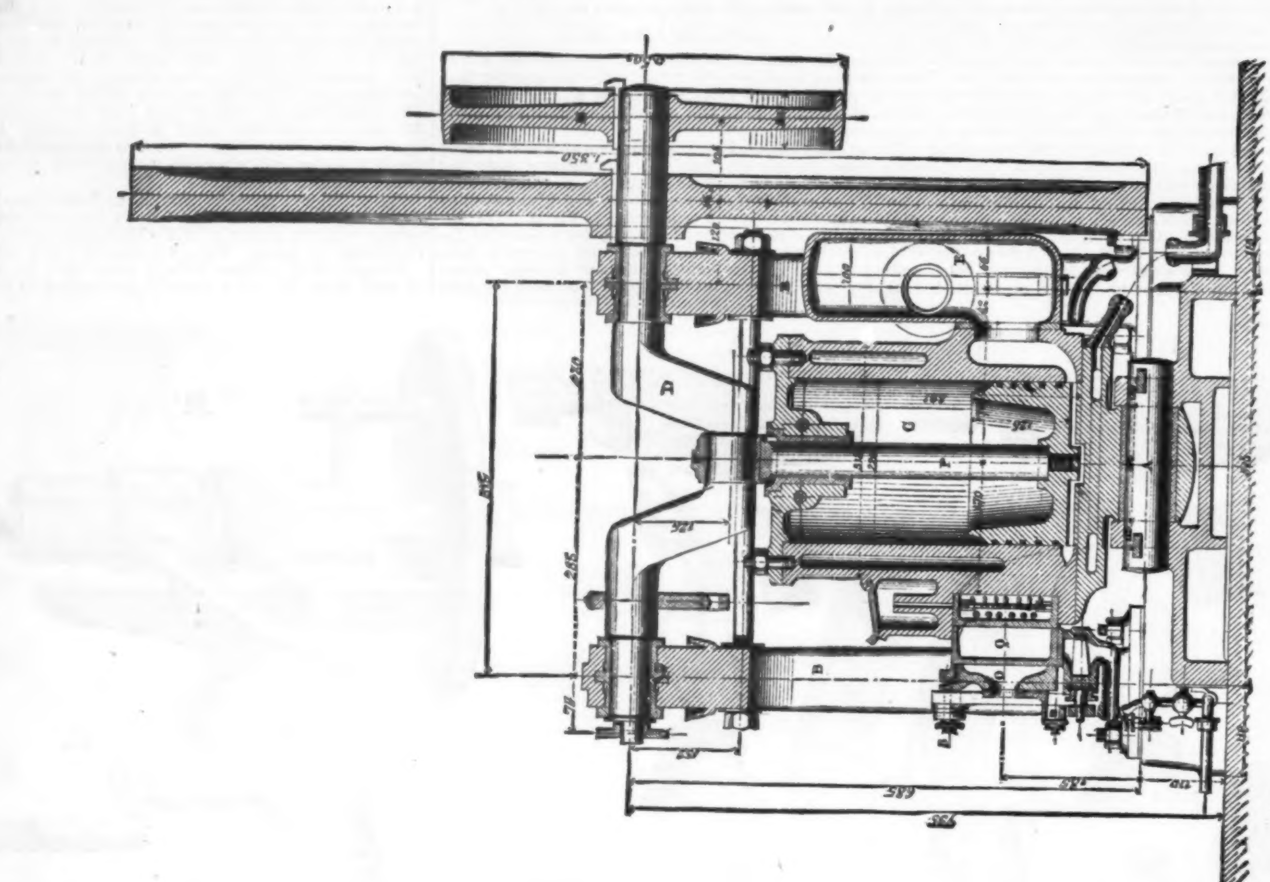


FIG. 2.—VERTICAL SECTION.

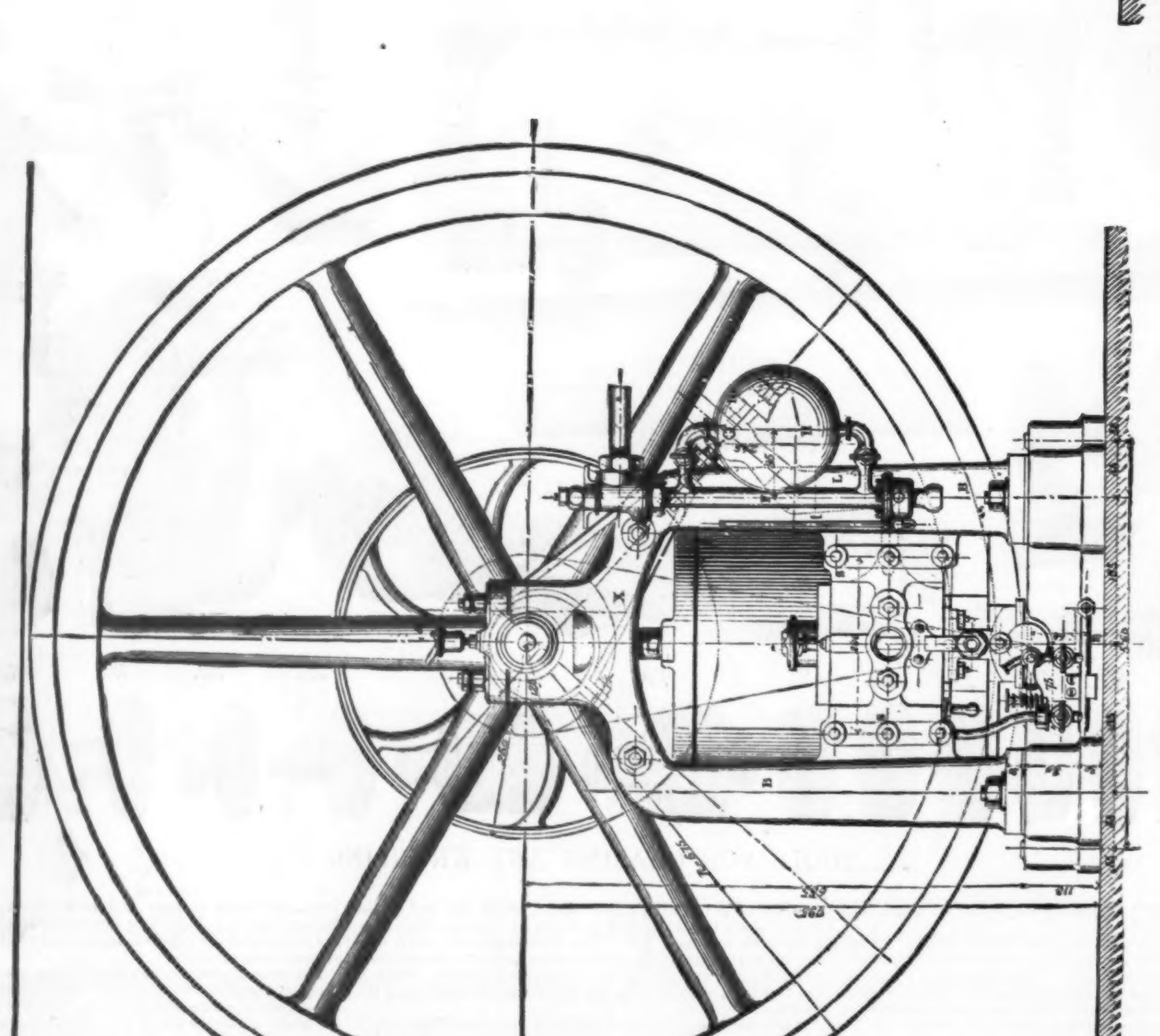


FIG. 1.—ELEVATION.

to the mortise in the arm it cannot move laterally without carrying the sliding rod and all attached to it. The tracing tool is slotted to receive a pin which passes transversely through the head of the tracing arm, and in the slot is placed a spiral spring which tends to throw the tracer forward.

The operation of this device needs no special explanation. The arm that carries the cutting tool is moved forward until its adjusting screw strikes the horizontal guide bar; the tracing tool at the same time engages the leading screw and carries all forward. When the tool has traveled as far as desirable it is drawn back and returned to its original position. With this tool threads may be cut on either cylindrical or tapering work.

It is sometimes desirable to form spiral grooves in the face of a disk; this may be accomplished in exactly the same manner as in the case of the cylindrical work. The method of doing it is illustrated by Fig. 15.

Knurls of various patterns are shown in Figs. 16 to 21 inclusive; these are employed in "beading," "milling," or knurling the heads of screws, the handles of small tools, etc. The manner of using this tool is shown in Fig. 22. The knurl is placed between the forks of a holder and upon a pin that passes through the fork, and is held with considerable pressure against the work as it revolves.

The knurls shown in Figs. 16, 17, 18, and 19 are easily made. All that is required is a hub something like that shown in Fig. 3. This is placed between the centers of the lathe, and the knurl blank is brought in contact with it and allowed to revolve in a holder supported by the tool rest. The straight blank is moved up and down until every part of the surface is cut in the same way. The concave blanks cannot be moved, but the hub should fit the hollow of the face of the blank. The knurl shown in Fig. 21 must be made by a die sinker. Figs. 23 to 28 inclusive represent examples of knurling done with the different knurls shown in the preceding figures.

THE RAVEL GAS MOTOR.

As this apparatus is comparatively new, we shall enter into all the details required by a complete description.

The Ravel gas motor consists of a vertical, single acting cylinder, C, oscillating on an axle, A, which is located at the lower part of the cylinder and forms a portion of the general frame, B, of the engine. It may be well to state in the commencement that, although this is an oscillating engine, the journal is solid and serves in nowise for the admission or escape of the gas. The upper part of the cylinder carries a guide in which slides the piston rod, P, which actuates directly the cranked shaft, D, upon which are keyed the fly-wheel, V, and the driving pulley, M.

In front there is a helicoidal wheel, which actuates a governor that is not shown in the engravings given opposite. The back part of the cylinder presents a plane surface in which there is a longitudinal aperture. This surface, as a consequence of the oscillatory motion of the cylinder, slides upon a phosphor-bronze plate, *b*, which is affixed to the frame by bolts bearing upon leather washers so as to preserve them from the effects of expansion. This plate is likewise provided with a longitudinal aperture, which communicates with the escape, E.

The parts are arranged in such a way that the apertures in the cylinder and escape meet each other at the moment the piston descends, that is to say, exactly, as we shall presently see, at the instant that the gases due to the explosion of the mixture exert their effect upon the cylinder, and are then to be expelled. In front is situated the distributing apparatus, consisting of a brass slide valve, Q, a cut off, O, and a gas chamber, R. The latter is provided with two apertures, one of them allowing the entrance of the air, and the other that of the gases. These two fluids enter the slide valve, the first mentioned through a rectangular aperture, and the second through a series of small tubes of different heights; and here, having mingled, they pass out together through circular apertures in the vertical side of the slide-valve. They are then obliged to redescend, pass through a sort of grating, and finally to traverse still another aperture in order to reach the lower part of the cylinder. The object of this arrangement is to bring about a perfect mixture of the two fluids. In the bottom of the slide-valve there is a cavity which faces a gas burner placed in the gas chamber. At every explosion this burner is extinguished, and is afterward relighted, when the slide-valve returns to its initial position by contact with a second burner, which remains continuously lighted during the operation of the engine. The object of the cut-off is to give passage at the desired moment to the air designed for the mixture, and to hold the gas chamber against the slide-valve. It is fixed to the frame by six milled nuts provided with leather washers to parry the effects of expansion. Motion may be communicated to the valve in several different ways.

The Ravel Gas Motor Company have on exhibition at the Paris Exhibition of Electricity two engines of one and two horse power. In one of the engines (and this is of the old pattern) a properly arranged cam, keyed to the driving shaft, revolves in a box which controls the slide-valve. It will be understood that this cam may be given such a shape that the motions of the valve shall be abrupt, and this is, in fact, the end toward which there should be a tendency. But owing to the necessity of opening and closing the admission rapidly, there result jerking motions. To avoid these, a very happy arrangement has been introduced in the use of a circular eccentric, and it is this arrangement that we show in the figures. The motion of the slide-valve could not be brought about directly by the eccentric, because of the too slow motion of the latter. The modification introduced is therefore as follows:

To the driving shaft there is keyed an eccentric, X, in an oblique position, provided with two tappets, *m* and *n*. The slide-valve carries a lever, L, which oscillates about the point, F, of the frame. The operation of the apparatus is then very simple.

Supposing the piston is at the end of its travel, admission begins, and the cylinder inclines toward the left, carrying in the same direction the slide-valve and the lever. The extremity of the latter then tends to move downward, but, the moment the quantity of gas and air is entirely drawn in, the tappet, *m*, of the eccentric comes in contact with the extremity, *l*, of the lever, and carries the slide valve to the right, thus closing the aperture of admission. The flame of the gas burner within the gas chamber lights the mixture and thus brings about a certain amount of pressure beneath the piston.

Now, the detonating mixture, at the moment it is fired, should possess a tension equal to that of the atmosphere. If the apertures of the slide-valve were closed at the moment of firing the mixture, there would result a depression of the latter, since, during the time that the slide-valve had taken to rise, the piston would have passed over some centimeters of its travel. To avoid so grave an inconvenience, it is necessary, then, that the firing should occur while the introduction of the mixture continues. The apertures which allow of the passage of the air and gases must remain open during the time that it takes the fire to spread to the gaseous mixture beneath the piston; and it is therefore necessary that the slide-valve should be given a rapid movement, without which there would result explosions in the interior, and, as a consequence, a disturbance in the working of the engine.

At the moment the piston descends, the escape opens; the products of combustion are expelled; then the tappet, *n*, of the eccentric comes in its turn in contact with the extremity, *l*, of the lever, and carries the slide-valve to its initial position.

The motions continue and things again take place in the same order as above indicated.

There will be noticed to the right of the engine a rubber bag, H. The object of this is to act as a compensator and to steady the flames of the burners which might chance to be lighted in the vicinity of the engine. The velocity with which the gas enters is definitely regulated by means of a winch cock. The regular action of the engine is insured of by means of a valve controlled by the rod, *t*, which is actuated by the governor.

The engine is, as will be seen, a single acting one; at every revolution the piston receives a new impulse, since there is no compression, and, with a comparatively small fly-wheel, it acts with a regularity which is perfect.

The effective work of the apparatus is about 70 per cent. Like the Otto engine, it requires from nine to eleven gallons of water per horse and per hour for the cooling of the cylinder. The great advantage of this engine consists in its ability to run a long while without stopping; while the Otto engine, on the contrary, has to stop quite frequently.

The following are a few figures in regard to a Ravel motor of one-horse power: Length of engine, 2·3 feet; breadth of engine, 2·13 feet; height, 3 feet; weight, including fly-wheel and pulley, 1,430 pounds; internal diameter of cylinder, 8·5 inches; stroke of piston, 9·8 inches; number of revolutions per minute, 100.

The consumption is, as in other motors, about 35·6 cubic feet per horse and per hour.

Finally, as with steam motors, the effective work increases with the power, and consequently the consumption of fuel follows the same law. Thus, in the Ravel motor, the effective work is from 65 to 68 per cent. in one-horse power engines, and from 70 to 72 per cent. in those of two-horse power. The consumption per horse and per hour decreases by about twenty gallons between the two types.

During the last eighteen months more than a hundred of these motors have been sold to the most diverse industries, and have enabled their owners to effect a great saving.

TO CRYSTALLIZE TIN PLATE.

THE *moir metallique* or crystallized tin plates are usually prepared from well annealed and well tinned charcoal iron plates, by rinsing the plates with dilute nitric or nitro-muriatic acid and then with water. The cleansed plates are dipped for a few moments into nitric acid or aqua-regia (nitric acid 1, muriatic acid 3), diluted with from one to three volumes of water and heated to about 180° Fah., and after a moment's exposure in this bath removed and rinsed in running water. This is repeated, if necessary, until the crystals are properly developed, when the plate is finally rinsed in hot water, which causes it to dry quickly without rubbing. The plates are then oiled or lacquered to preserve them. Plates which have been heavily rolled or too quickly chilled after tinning do not afford a good crystallized surface. Hot tannin or strong caustic soda solutions can also be used to develop the crystalline structure of tin plates.

MR. LAWSON'S BOILER EXPERIMENTS AT PITTSBURG, PA.

To the Editor of the Scientific American:

Feeling under obligations to you for the impartial manner in which you have noticed my recent experiments in the explosion of a steam-boiler at Munhall Farm, near Pittsburg, Pa., I take pleasure in furnishing you, as requested, a detailed statement of the same.

To aid in a clear conception of my experimental tests, it may be necessary to briefly state the theory upon which they were based. I believe that any kind of water, hard or soft, from lake, river, or spring, if subjected to a high degree of heat, by superficial means, which requires pressure, will *burst into steam* the instant that pressure is removed from its surface, and if the exploding water is met by a resisting force, as in a closed boiler, the concussive effect must be much greater than the regular steam pressure. Take a one-pound weight and hold it a few inches above a table, and the force exerted between thumb and finger resists just one pound, so each square inch of a boiler resists one hundred pounds force, when the water is heated to 338°. Let the suspended weight fall upon the table, and the stroke would be sufficient to mash the finger which held it. Thus, if the pressure be suddenly removed from the water, either by instant condensation of steam or by filling a closed cylinder from the boiler, the concussive effect of the exploding water on each square inch is too often beyond its power of resistance.

To demonstrate this theory, I had a cylinder-boiler built by W. W. Roberts, Wellsville, Ohio, using the best iron obtainable, it having been manufactured on special order by Messrs. Phillips, Nimick & Co., Pittsburg, Pa. Its length was 6 ft., diameter 30 in. Its heads were of three-eighths flange iron, and shell three-sixteenths. The heads were secured by one-inch rod from head to head, firmly bolted. It was set up by Messrs. Willson, Snyder & Co., Pittsburg, on the grounds of John Munhall, Esq., where the government commissioners made their tests a few years ago, the bomb-proofs being yet in good condition. It was first designed to make the test by creating vacuum by condensation of the steam in the boiler, but fearing the action of the pump might not inject the cold water quickly enough for my purpose, I determined to use a cylinder. I had the cylinder attached to the boiler by means of a two-inch pipe leading from the top of the boiler (which was set up horizontally) to the end of the cylinder, which was perfectly closed, except as we opened the small steam cock for discharge of steam after test. In this connecting pipe and near the cylinder, some 30 feet from the boiler, was placed a quick lifting valve, operated by cord and pulley from the bomb-proof. A first-class government steam-gauge was attached to the boiler by about 40 feet of quarter-inch pipe leading to the bomb-proof. The boiler was set with the fire line two inches below the center, and filled with water to within six inches of the top, the fire line being at the start of my tests about 11 inches below the water line, and at the close not less than 9 inches. I was particular in these conditions, as I was assured by practical gentlemen of large intelligence, in other matters at least, that it would be utterly futile to attempt the explosion of a boiler of such strength when well filled with water, and especially when the fire line was entirely below the water line.

On June 7, I made my first tests, assisted in the bomb-proof by Peter Young, a youthful mechanic, of more than ordinary tact and judgment, as well as nerve, who was detailed for the purpose by Willson, Snyder & Co. Steam being up to 65 lb., the valve was raised without any effect, except vibration of the index on the gauge to the extent of 15 to 30 lb. This was continued as pressure increased, at each 10 to 15 lb. rise, till we reached 165 lb., at which point, as the valve was raised, the thread was stripped off the bolts of the cylinder head, and the gasket blown out with a loud report, which ended our experiments for that day. I at once ordered the cylinder repaired, and after several days of detention by extraordinary floods, we got all things ready by the 16th, for the final test.

I became satisfied before, the small cylinder gave way, that I had made a few mistakes in some of the details, as I had anticipated would be the case. The strength of the boiler had not been calculated, and I had supposed that a force of 400 to 500 lb. to the square inch would rend it. By government rule, placing the iron at 50,000 tensile strength, the strength of the boiler would be 625 lb. to the square inch, but this iron is claimed by experts familiar with it to be of not less than 57,000 tensile strength, which would make that of the boiler 712½. Then the pipe connecting the cylinder with the boiler was only two inches diameter, which caused the steam to enter the cylinder with a slightly prolonged flow, the hiss of which was plainly audible in the bomb-proof. The retarded flow of steam from the boiler greatly reduced the concussive effect of the bursting water, and as upon the *instantaneous check* depended the successful issue of my experiment, I should have had the connection enlarged had it not been for the fact that I saw by the gauge, each time the valve was raised, a vibration of 20 to 30 lb. up or down from the existing power effected through over forty feet of quarter-inch pipe connecting the gauge with the boiler. I reasoned that the effect shown upon the gauge through so great a length of small pipe filled with steam and compressed atmosphere could not be more than one-tenth of that in the boiler. Having ascertained the approximate strength of the boiler, and being satisfied of the defective size of the connection pipe, I anticipated explosion at not less than 300 to 400 lb. pressure.

The furnace being in fine condition, the spectators placed themselves in the visitors' bomb-proof, and after charging the furnace with a supply of fuel, to be aided by a flow of oil under our control, we placed ourselves in a substantial bomb-proof some 30 feet from the boiler. Steam being up to 260 lb., I raised the valve, with effects similar to those of the previous tests. This was repeated with like results at 300 lb., at 335, and at 365 lb., the boiler remaining perfectly steam tight, not a joint leaking. At 380 lb., as I raised the valve a report similar to that of a large cannon was heard, followed by the rattling of falling *debris* in the vicinity. A few seconds later we stepped out of the bomb proof and were met by a falling mist, produced by condensation of steam high above us. Examining the ground where the furnace and boiler had stood, nothing was found but a few of the scattered and broken grate bars; the stone foundations sunken several inches into the ground, and the fire brick walls some three feet high on top of them, entirely gone; not a spall of the stones to be seen. Portions of the boiler found scattered in the surrounding locality indicate plainly that the plates were rent in twain at least four times transversely, and torn open the entire length. One piece was discovered with a hole blown through it about the size of a man's hand, the ragged edge attesting the extraordinary force of the stroke which effected so peculiar a result. The heads were considered the weakest parts, yet one of them was found with a portion of the entire circumference of the shell attached, not a rivet loosened in it. A few small pieces have been found torn into strips, the seams running in every direction. *There was no "initial point."* All went at the same instant, cross joints and single sheets alike. Not an ounce of water to be seen—it all went into steam.

It is held by many who have made this question of steam explosions a study, that, when at high pressure, it is only necessary to open a large valve and let the steam escape to produce explosion of the boiler. This is certainly a mistake. I have it from reliable authority that this test was applied ten to twelve times by the government commissioners at Sandy Hook, at very high pressures, and the effect was invariably a lowering of pressure without injury to the boiler. It is not the quick escape of steam when the flow is continuous that is dangerous; but when the highly heated water explodes into steam from the removal of pressure from its surface, and is met by instant resistance (as by the filling of a closed cylinder), the concussive effect upon each square inch of the boiler is too often irresistible. Again, if colder water be injected into the boiler so as to strike the steam, instant condensation removes the pressure from the water in the boiler, and explosion follows. If coroners' juries had investigated from the stand point that it was cold water striking *hot steam* instead of *hot iron*, a thousand mysteries would have been made clear as to the cause of explosions, and many engineers, who have been unjustly censured for negligence, would have held a good position in their calling.

With the experience obtained in these first attempts to explode a boiler, I have no doubt that, with the necessary changed conditions, I can effectually succeed in bursting a boiler of like strength with one-fourth to one-third the pressure used in this case. There are two prime requisites: *plenty of water*, which is the store of energy—*heat*—and a full *concussive effect* on the boiler, unbroken by wrong conditions.

It is a common belief that any boiler will explode, if the pressure is greater than its power of resistance. Many tests heretofore made prove this erroneous. In test cases, where well-made boilers have been subjected to a steam pressure above their power of resistance, the effect has been the loosening of rivets, straining of joints, and the gradual escape of steam through these slight openings, by which the pressure was reduced, but nothing in the nature of explosion occurred. The government commissioners were reported to have ruined several good boilers by enormously high steam pressure, yet failed to produce an explosion.

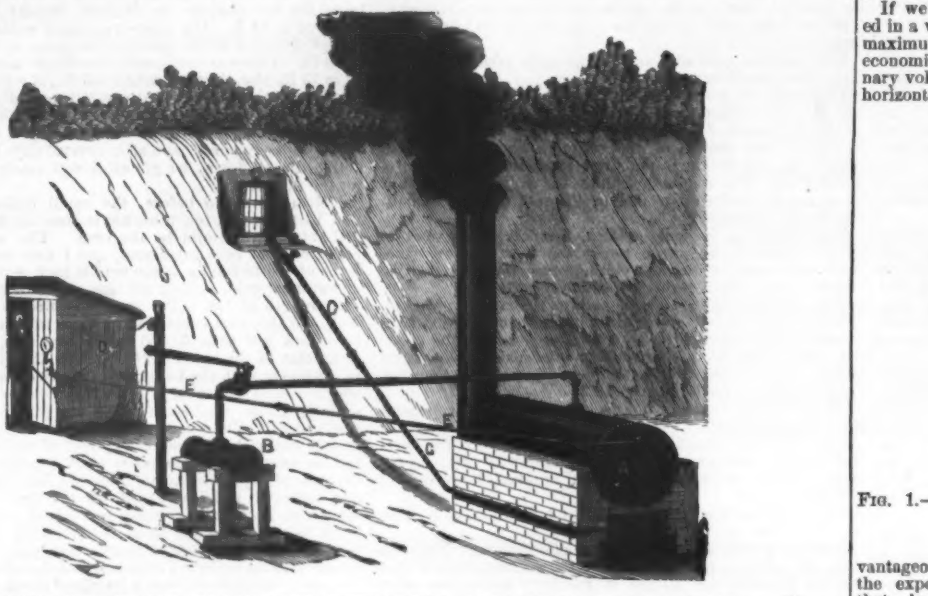
Accidental explosions occur in a quite natural way, and he who would explode a boiler must comply with the demands of natural laws or fail. So if we would avoid explosions we must understand the plain demands of these laws and cease to violate them. D. T. LAWSON.

Wellsville, O., 1881.

EXPERIMENTAL BOILER EXPLOSION.

MR. D. T. LAWSON, of Wellsville, Ohio, as our readers know, has been conducting experiments with a view to determining the nature of the causes of the explosion of steam boilers, and as a result of these experiments he maintains that his original theory of boiler explosions is correct.

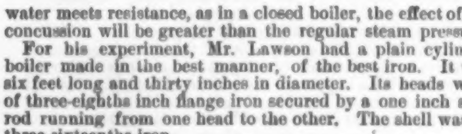
He believes that water raised to a high temperature, when confined and under pressure, will burst into steam when the pressure is removed from its surface; and if the exploding water meets resistance, as in a closed boiler, the effect of the concussion will be greater than the regular steam pressure.



LAWSON'S EXPERIMENTAL BOILER EXPLOSION—ARRANGEMENT OF BOILER.

For his experiment, Mr. Lawson had a plain cylinder boiler made in the best manner, of the best iron. It was six feet long and thirty inches in diameter. Its heads were of three-eighths inch flange iron secured by a one inch stay rod running from one head to the other. The shell was of three-sixteenths iron.

The boiler was set in an arch and connected by a pipe with a closed cylinder, into which steam was admitted to suddenly relieve the surface of the water in the boiler from pressure. A first-class steam gauge was placed in the bomb-proof and connected with the boiler by a pipe about forty feet long. The valve, controlling the escape of steam from the boiler to the cylinder, was arranged to be operated by a cord from the bomb-proof. The boiler was filled with water eleven inches above the fire line, and the fire was supplied with extra fuel in the form of petroleum, the supply of which could be controlled from the bomb-proof. After a few preliminary experiments the final and successful one was tried on the 16th of June last.



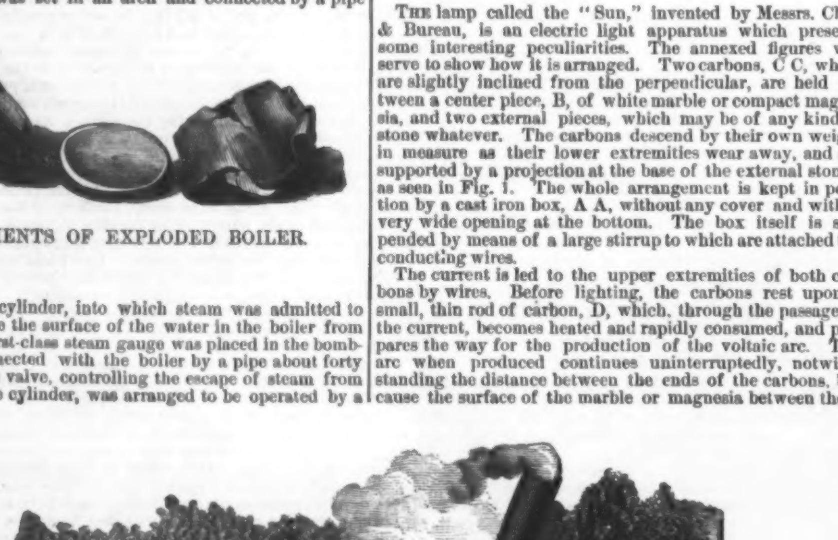
FRAGMENTS OF EXPLODED BOILER.

Steam was raised to 260 lb., when the valve was opened, the index of the steam gauge fluctuated some 30 lb., showing an extraordinary disturbance in the boiler, and nothing more. A repetition of this with steam at 300 lb., at 335 lb., and at 365 lb., produced the same results. But when the valve was opened at a pressure of 380 lb., the boiler exploded with a loud report, scattering fragments of its shell, furnace, and stack in all directions. The stone foundations were driven several inches into the ground.

It is stated that there were evidences that the plates were rent at least four times transversely and torn open the entire length. One piece had a hole blown through it about the size of a man's hand.

It was estimated that the boiler would have borne a continuous pressure of over 700 lb. per square inch. There seems to be ample evidence that it required an extraordinary force to effect the destruction of the boiler.

We understand that Mr. Lawson has some further experiments in contemplation which he expects will furnish additional proof of the correctness of his position.



LAWSON'S EXPERIMENTAL BOILER EXPLOSION.

THE SUN LAMP.

THE lamp called the "Sun," invented by Messrs. Clerc & Bureau, is an electric light apparatus which presents some interesting peculiarities. The annexed figures will serve to show how it is arranged. Two carbons, C C, which are slightly inclined from the perpendicular, are held between a center piece, B, of white marble or compact magnesia, and two external pieces, which may be of any kind of stone whatever. The carbons descend by their own weight in measure as their lower extremities wear away, and are supported by a projection at the base of the external stones, as seen in Fig. 1. The whole arrangement is kept in position by a cast iron box, A A, without any cover and with a very wide opening at the bottom. The box itself is suspended by means of a large stirrup to which are attached the conducting wires.

The current is led to the upper extremities of both carbons by wires. Before lighting, the carbons rest upon a small, thin rod of carbon, D, which, through the passage of the current, becomes heated and rapidly consumed, and prepares the way for the production of the voltaic arc. The arc when produced continues uninterruptedly, notwithstanding the distance between the ends of the carbons, because the surface of the marble or magnesia between them has had time to become a conductor through being heated during the period preparatory to lighting.

This arc, which is of great length, on grazing the marble produces an intense light which presents at once the characters both of the electric and Drummond lights. The light is of a yellow color, and this has given the light its distinctive name of "sun," while the ordinary voltaic arc produces an effect which recalls the light of the moon.

The sun lamp has the advantage that it throws all its light downward, that is to say, toward those parts that we usually desire to illuminate. This advantage, however, should not be overrated; for we may remark, in the first place, that the total suppression of light above leaves the ceiling in a darkness that sometimes does not have a very agreeable effect. Moreover, it is necessary to recognize the fact that the different pieces which surround the marble at its luminous part cast a shadow and allow only a quite limited spread to the luminous rays. Fig. 2 shows this appearance, but exaggerates it. The truth is that the illumination is very intense in a vertical direction, and rapidly diminishes away from it; but it is given out at a greater angle than that shown in Fig. 2.

If we are correctly informed, the light has been measured in a vertical direction, that is to say, in the direction of maximum intensity. This, however, renders impossible an economic comparison of this source of light with the ordinary voltaic arc lamps, which are generally measured in the horizontal, although such is far from being the most advantageous direction. However this may be, it results from the experiments recorded in Mr. Desguin's pamphlet that, in one particular case, the light produced per lamp corresponding to 1¼ horse power was equal to 120 carcels, that is to say, nearly 100 carcels per horse. In another series of experiments it was found that the results varied from 50 carcels per horse, with an intensity of 5 webers, to 110 and 125, with 15 to 20 webers. Moreover, the luminous intensity may vary from 50 to 1,000 carcels, according to the distance of the carbons and length of the marble and the intensity of the current.

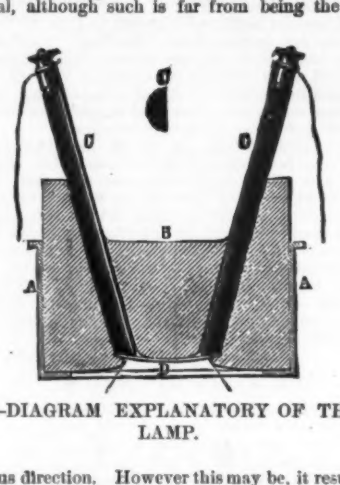


FIG. 1.—DIAGRAM EXPLANATORY OF THE SUN LAMP.

One apparent defect of lighting by alternating currents is found also in the present system: we refer to the noise or humming sound that the lamps make. This sound varies in loudness with the number of alternating currents which succeed one another in a given time. In illuminations in the open air this inconvenience does not exist, but in drawing-rooms or public halls it is very marked. The noise has been successfully suppressed by the use of perfectly closed globes, the fact that the lamp leaves no products of combustion to soil the glass rendering such a solution of the problem practical. This satisfactory result may be observed at the Exhibition of Electricity, in hall No. 1 on the first story, where ten sun lamps are now throwing a very agreeable light on the pictures which decorate it. It seems to me that the lamp is there entirely in its place and to its best advantage.

The luminous point in Mr. Clerc's lamp is absolutely fixed, which is indeed an advantage; but another much more important feature is the absolute stability of the light. From the latter point of view it stands in the same category with incandescent lamps.

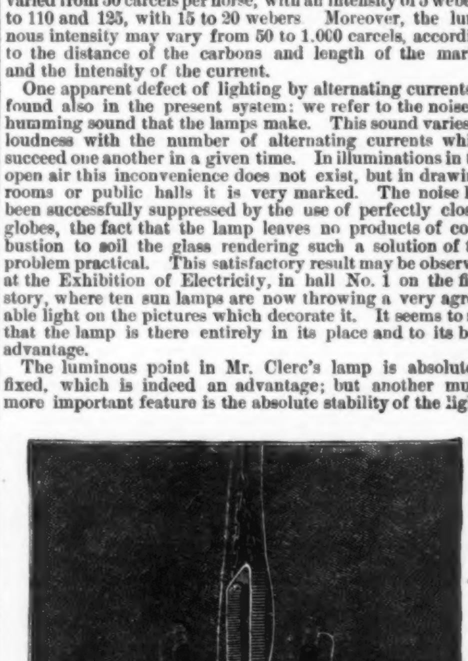


FIG. 2.—GENERAL VIEW OF THE SUN LAMP.

Finally, the chief merit of the sun lamp lies in its long duration, that is to say, in the considerable length of time during which it can operate without stopping, without renewal of carbons and without care. The two carbons, which have a semicircular section of one centimeter radius, last a very long time because their combustion is very slow. The wear of the carbons varies from 8 to 15 millimeters, according to the intensity of the current; and this intensity may vary from 3 to 25 webers, owing to the simplicity of

the lamp. The length of the carbons may itself be varied from 5 to 30 centimeters, according to the length of time it is decided to have the light. And, finally, the lamp may operate 15 or 16 consecutive hours if necessary.

The block of marble between the two carbons likewise wears away; the very high temperature to which its lower portion is exposed brings about a decomposition of the carbonate of lime, and it is the lime that is incandescent. This substance becomes vitrified, and thus, to a certain extent, protected against ulterior wear. A block of marble may last for twenty hours at a stretch, or furnish two lightings of ten hours each. On another hand, if used for two or three hours at a time, its duration is less. Finally, when the block is left for several days, the vitrified portion becomes fissured and the calcined lime behind it crumbles into powder, so that the block ceases to be utilizable.

The length of the arc may vary from 10 to 60 millimeters, according to the resistance given it. In a short circuit, a greater intensity and not so thick a marble are employed; but, in a long circuit, there will be needed more tension, less intensity, and a thicker block of marble. The lamps most used in practice have marble or magnesia blocks from 10 to 20 millimeters thick.

For some time past, compact magnesia has been substituted for marble, as it lasts much longer (in some cases as much as a hundred hours); but if it is impure, and contains silica, for example, its duration is of short extent.

The sun lamp is in operation at Brussels, at the Royal Tavern; it is lighting the Westminster Panorama at London, and Parisians may see it at the Electrical Exhibition, where, as before stated, it is advantageously illuminating the picture gallery.—*A. Niaudet, in La Nature.*

THE REAL INVENTOR OF THE TELEPHONE.

To the Editor of the Scientific American:

In No. 10, on page 164, of the SCIENTIFIC AMERICAN, we meet with a correspondence signed "Gravity," requesting to hear from others their views on the subject of Mr. Bell's claims to the inventorship of that valuable space annihilator and distance talker, the telephone. If that request, as it seems, meets with your approbation the following lines are at your disposition.

In his late decision of Bell's telephone suit, Judge Lowell said "*Bell discovered a new art of transmitting speech by electricity*, and that he therefore had a right to hold the broadest claims for it which could be permitted in any case." With that judgment no doubt the judge committed a great blunder, and Mr. Bell, if an honest man, ought himself take out a "writ of error" against it.

I will give here an abridgment of the history of that invention, by which the public will be enabled to judge for itself how far Mr. Bell is entitled to his claims as the inventor of the telephone.

Philip Reis (pronounce Rice) was born in Gelnhausen, near Frankfort on the Main, on January 7, 1834, the son of a baker. The teachers of the public school, which Reis had entered in time, discovered early remarkable mental faculties in the boy, and induced his father to send him to a higher educational institution. Thus he became a scholar of Garnet's Institute of Frankfort, where his inclination for the study of natural sciences became developed. Unfortunately his father died too early for the boy, and the appointed tutor did not favor the boy's inclination, but sent him as an apprentice to a merchant dealing in paints. Every spare hour he could obtain here Reis devoted to his former studies, besides instructing himself in physics and mathematics. In the year 1858 we find him employed as a teacher in the same institution where he had received his first lessons in his favored studies, and it is from here that we become first conversant with his important discovery of the telephone in a lecture he delivered before one of the scientific institutions of Frankfort.

"It was in 1860," he said, "while pursuing my studies of the organ of hearing, that I succeeded in the construction of an apparatus by which that organ, the ear, could be better demonstrated, and with which also *sounds could be sent to distant places with the assistance of the galvanic current and could be reproduced.* I gave to the instrument the name telephone."

Reis, so tells us his biographer, had the satisfaction of seeing his invention highly appreciated and to be complimented by the Natural Philosophical Society of Giessen, the University of Hesse Darmstadt.

In the annual reports of the Physical Society of Frankfort of 1860-61, we find published a lecture of Reis on telephony by the galvanic current, which lecture he had delivered publicly in Frankfort, containing a complete description of the apparatus, etc.

This may be sufficient to locate the invention of the telephone. Reis should not earn all the fruits of his labors. He died, as poor as he had lived, on the 14th of February, 1874, of pulmonary consumption.

When we now observe, after the lapse of eighteen years after that remarkable discovery of Reis, another one not only claiming that invention as his own, but basing upon that claim rights with the object of enriching himself, and when we are informed, besides, that judgment has been rendered in favor of that sham-pretension, we indeed do not know which more to despise, the bold appropriation by Bell or the ignorance of Judge Lowell.*

In the name of truth, and of the noble, illustrious benefactor of mankind, who bestowed upon civilization one of the most important inventions of this century, giving it voluntarily and without any other compensation than the recognition his genius deserved, let us repudiate with scorn and indignation the selfish and greedy sham-pretension of a man who cannot present a proper legal claim nor title of his invention. *Transeat in exemplum.*

M. SCHUPPERT, M.D.

New Orleans.

A MANGANESE BATTERY.

By J. ROUSSE.

INSTEAD of the zinc in a Bunsen element the author uses ferro-manganese. As the liquids, he uses sulphuric acid at one-twentieth and concentrated nitric acid, or if a feeble current is required, instead of the latter, potassium permanganate. The salts produced are manganese sulphate and nitrate.

* I will expressly state here that I have nothing to do with the deserts Mr. Bell may claim of having brought telephony into public favor, nor with his claims, if he has any, of having improved the instrument. I am exclusively dealing here with his pretended claims as the inventor of the telephone, the instrument of propagating sound to distant places with the assistance of the galvanic current.

METHODS OF MEASURING INACCESSIBLE HEIGHTS AND DISTANCES.

By THOS. ED. CANDLER.

IT would be impossible for us to lay down any fixed rule for the student to go by in the determination of unknown heights and distances by instrumental operations, because no two cases are alike in this respect, and it entirely depends upon the knowledge which he possesses of the geometrical

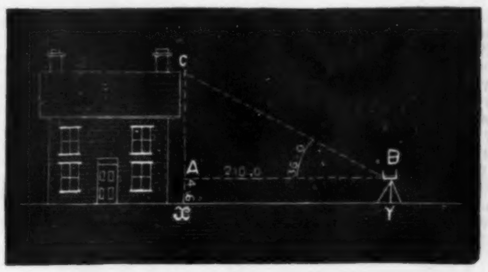


FIG. 1.

part of the subject. We will give two or three simple methods in which instruments are used, and will then leave it.

It is required to find height of the house (Fig. 1), which is assumed to be perfectly perpendicular. Set your instrument at B, 210 ft. (or any other convenient distance), and measure the angle at B, 36 degrees; run a level line from B to A, and plot the line A B 210 ft. to any suitable scale, mark off at B an angle of 36 degrees, and raise a perpendicular from the point A, which will give you the height of the house + A x, 4 ft. 6 in.

If a house or other building is intercepted by a river or

FIG. 2

other obstacle, set your instrument at a suitable point, A, and measure your angle to C, 30 degrees; measure out any convenient distance to B, say 116 ft., and fix your instrument again perfectly level (so as to get point x on the wall), measure angle to C, 23 degrees. Now plot A B 116 ft. to scale, and mark off angle at A of 30 degrees and angle at B of 23 degrees, and from the point C, where they cut, drop a perpendicular to x. This + 3 ft., height of x from ground, will give the height of the building.

To find actual height of the statue (Fig. 3): Set your instrument at B, and take your point A immediately under the statue; measure your base, A B, say 50 ft., and measure angle to C, 45 degrees, and angle to D, 47 degrees 30 min.; erect perpendicular A D, and C D will, measured to scale, give the actual height of statue.

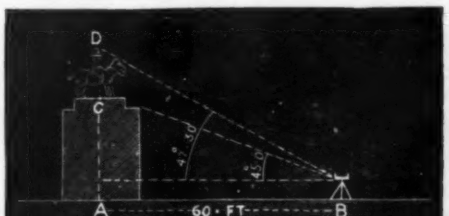


FIG. 3.

To Lay off a Perpendicular with a Chain.— Let A be the point in the line A B at which it is required to erect a right angle (Fig. 4); fix the 20 of the chain at the point A by an arrow, and measure 40 links, A x; fix the other end of chain at x, which will leave 80 links between the two fixed points at A and x; take hold of the 50 of the chain and

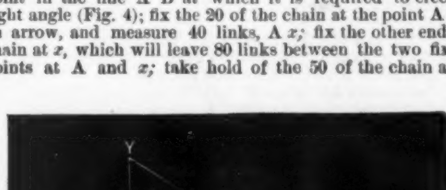


FIG. 4.

stretch it out as far as it will go to point y, when A y will be perpendicular to A B, because $\sqrt{30^2 + 40^2} = 50$ (*Euclid* I., 47.)

To continue a base line* over an inaccessible river when the base line is nearly at right angles (Fig. 5): From the point C, measure back 400 links to A, and fix flags; raise a perpendicular at D and B, of 300 and 600 links respectively, and fix flags; measure A D and D B, which should each be 500 links, otherwise something is wrong; now send some one with a flag to point x which must be fixed in a line with A C and B D; then the distance C x will be equal to A C, 400 links.

* For these methods I am indebted to H. S. Merritt on *Surveying.*

The same when base line crosses the river obliquely (Fig. 6): Set out line D B E, and at any part of the line, say E, 400 links from B, set off E C at right angles to E D, having a flag fixed at C, in a line with A C; measure from B to D 400 links, the same as E B, and raise a perpendicular at D

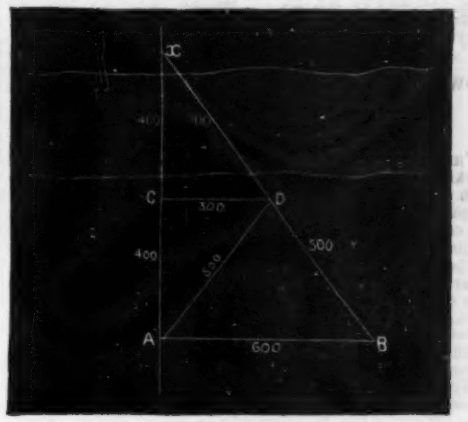


FIG. 5.

to point A; measure the distance A B, which will be the same as B C, viz., 475 links.

If you were in some trouble in taking the offsets of any building, etc. (Fig. 7), as to whether you were measuring

FIG. 6.

from points on the chain truly at right angles to such chain line, or assuming that at the point x it was impracticable to take such offset, a very easy method is to take two points in your chain, as at 15 and 35 and also at 90 and 110; measure

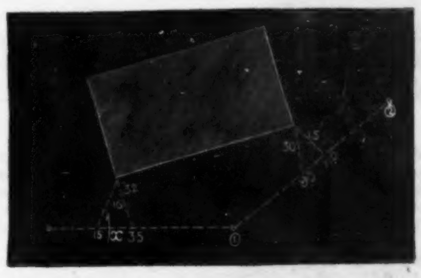


Fig. 7.

from these points to required offset, which, when plotted, gives you the accurate distance from your survey line.—*Colliery Guardian.*

TO PRESERVE AUTUMN LEAVES.—Sumac and the leaves of similar plants or trees are usually gathered early in October. Maple, alder, oak, linden, etc., are now at their best. To preserve the leaves they should be thoroughly dried as soon as possible after gathering and trimming. A simple method of drying the leaves expeditiously is the following: Spread the leaves and press in a suitable pan with alternate layers of fine sifted dry sand heated as hot as the hand can bear, and set aside to cool. When the sand has cooled the leaves may be removed, smoothed under a hot iron, dipped for a moment in clear French spirit varnish, and allowed to dry in the air. Melted paraffine and wax are sometimes preferred to the varnish. The following is another way: Spread several thicknesses of fine wrapping paper on the ironing table; arrange the leaves of the spray, picking off those which do not add to its beauty, and lay it out smooth. Pass a warm flat iron over a cake of wax and then over the leaves—first on one side and then on the other. Then place the sprays between sheets of bibulous paper, and put under pressure between two flat boards, for several weeks, changing the paper several times.

RESIDENCE, MILFORD MANOR ESTATE, SALISBURY.

THE house illustrated was recently built for Mr. George Nodder, upon the Milford Manor estate, at the north end of the property. The house is built of brick, faced with the Fisherton white bricks and Bath stone dressings. Messrs. Young & Sons, of Salisbury were the contractors, their tender being £1,500, exclusive of the boundary-walls. The interior decorations have been tastefully executed by Mr. H. D. Martin, under the direction of the architects, Messrs. John Harding & Son, of Salisbury.—*Building News.*

HOW ENGLISH OPERATORS WORK GELATINE PLATES.

By J. HAY TAYLOR.

THE following notes, descriptive of the whole routine of working with gelatine plates in England, are intended for such professional portrait photographers as are desirous of adopting gelatine in their ordinary practice, but who, from one cause or another, have not had an opportunity of becoming acquainted with its minor details.

The camera and dark slide must be thoroughly tested in order to ascertain that they are quite light proof; the window of the dark room must have two thicknesses of ruby glass, and all cracks which allow even the faintest white light to enter (and which in collodion practice may be considered insufficient to make any difference on a negative), must be thoroughly blocked up.

We are now in a position to attempt a negative which is exposed in the ordinary manner. The sensitiveness of a dry plate for studio use being greatly in excess of that of wet collodion, the exposure must be regulated and reduced accordingly. On removal from the camera it is next in turn to develop. This is done either in a flat porcelain dish or an ebonite tray, the latter being preferable, as the former is generally constructed with a slightly uneven bottom, so that a quantity of the developer is used to fill up the vacancy between the plate and the bottom of the tray.

As a general developer, which can of course be modified to suit the requirements of various plates, the following is to be highly recommended. The alcohol contained in it is useful in the case when a plate is liable to frill slightly, as in most cases it checks it. The citric acid improves the *keeping* qualities.

Pyrogallic acid	1 ounce.
Alcohol	4½ ounces.
Water (in which has been dissolved 10 grains citric acid)	4½ "

This is mixed with 100 ounces of water, and labeled P.

Bromide ammonium	300 grains.
Water	6 ounces.

This solution is kept in a bottle labeled B.

Liq. ammonia (8·80)	1 ounce.
Water	3 ounces.

This is marked A.

In order to develop, say, a half plate, place it in the developing tray and allow it to remain filled with water for a few seconds, and afterwards pour away; then into a developing cup pour two ounces P solution, and thirty minims of B; pour this on the plate. Next, into the developing cup place thirty minims of A, pour the contents of the tray back into the cup so as to insure thorough mixing, and flood the plate with the same. In about twenty seconds the high lights will begin to appear, continue to rock the tray until the whole of the image appears to be well out by reflected light; then viewing it by transmitted light, it can readily be ascertained if it has acquired sufficient density. During development air bubbles are apt to settle upon the plate and produce clear spots; these must be instantly brushed aside by means of a very soft brush.

The plate having been rinsed, it is placed in a fixing bath composed of hyposulphate of soda, about the strength used for collodion negatives, with the addition of a few drops of alcohol. After fixing, the plate is transferred to a saturated solution of alum in water and allowed to remain therein for about a minute; this has the effect of hardening the gelatine.

It is then transferred to a washing trough or grooved box containing water, which should be periodically changed. After a few hours of this treatment all traces of hypo will have been removed, and the negative can be racked up to dry, which will take several hours, or if the atmosphere be very damp, even a few days. Should it, however, be desirous to use the negative without delay, it may be immersed, for a few minutes, in a dish of alcohol, which will displace the water from the film; it will then dry in a few minutes; in fact, as soon as the alcohol has evaporated.

On no account must the negative be heated until the gelatine is quite dry, as the image will become distorted.

When dry, warm the negative, and varnish. A good varnish for this purpose can be made as follows:

Alcohol	30 ounces.
Shellac	1 "

Place this in a vessel, which set into hot water for about a quarter of an hour, then add

Powdered gum sandarac	2½ ounces.
Gum benzoin	2 "

Shake well at intervals for a few minutes, allow to settle for a few hours, and then filter. But it is much better to purchase the varnish ready made.

As a means for retouching upon the negative, it is preferable to use a medium, as the retouching can be removed, if desired, by a fresh application.

Resin	½ ounce.
Turpentine	2 ounces.

Moisten the end of a finger with the foregoing, and rub over the face with a circular motion until it becomes very sticky, then allow it to dry for a few minutes.

It has been taken for granted that in the manipulations described everything has proceeded in a satisfactory manner, that the negative has been properly timed, that it is possessed of good printing quality and of sufficient density, and free from fog or stain.

During the development it must be remembered that the ammonia acts as an accelerator, and the bromide as a restrainer, the greater the quantity of bromide used, the slower will be the development and the clearer the negative. An excess of ammonia tends to produce fog.

If, from over exposure or under development, the image is flat or wanting in vigor, the negative can be remedied by the use of an intensifier. That which in the course of my experience with various plates I find the most efficacious consists of bichloride of mercury one ounce, dissolved in one and a half pints of hot water. Then add one and a quarter ounces iodide potassium previously dissolved in five ounces of water. This will give a red precipitate consisting of iodide of mercury. This precipitate is allowed to settle, and the clear portion decanted; it is then redissolved by adding, little by little, a strong solution of hyposulphite of soda, after which ten grains of hypo are added, and sufficient water to make a quart. The negative will, in this solution, gain sufficient intensity in from a few seconds to as many minutes, without any stain, provided all traces of the fixing solution had been removed by washing. After intensifying it must be again well washed. If not thoroughly washed at this stage, the negative is not only liable to fade, but it takes more than double the time to dry than it otherwise would.

With some plates, after removal from the fixing, the image is of a very yellow color. This can be removed and the negative made to look like one taken with collodion, if for a few seconds it is immersed in a solution of

Hydrochloric acid	1 ounce.
Water	1 pint.
Alum	1 ounce.
Boracic acid to saturation.	

In some cases a negative may have acquired a degree of over density, perhaps through being forced up in development. This may be reduced by an application of

Holmes' ozone bleach	1 part.
Water	8 parts.

Green fog is a source of great annoyance to those whose aim it is to produce negatives that are faultless. This kind of fog is generally manifest on the back of the negative, and it is seen by reflected light. If slight, it in no way retards the printing qualities of a negative, but in can generally, though not always, be made to disappear by immersing the film in a strong solution of bichromate of potash, and afterward well washing. There are many causes of this kind of fog, among others being an excess of ammonia in developing, the gelatine film being too thin, and an under exposed negative.

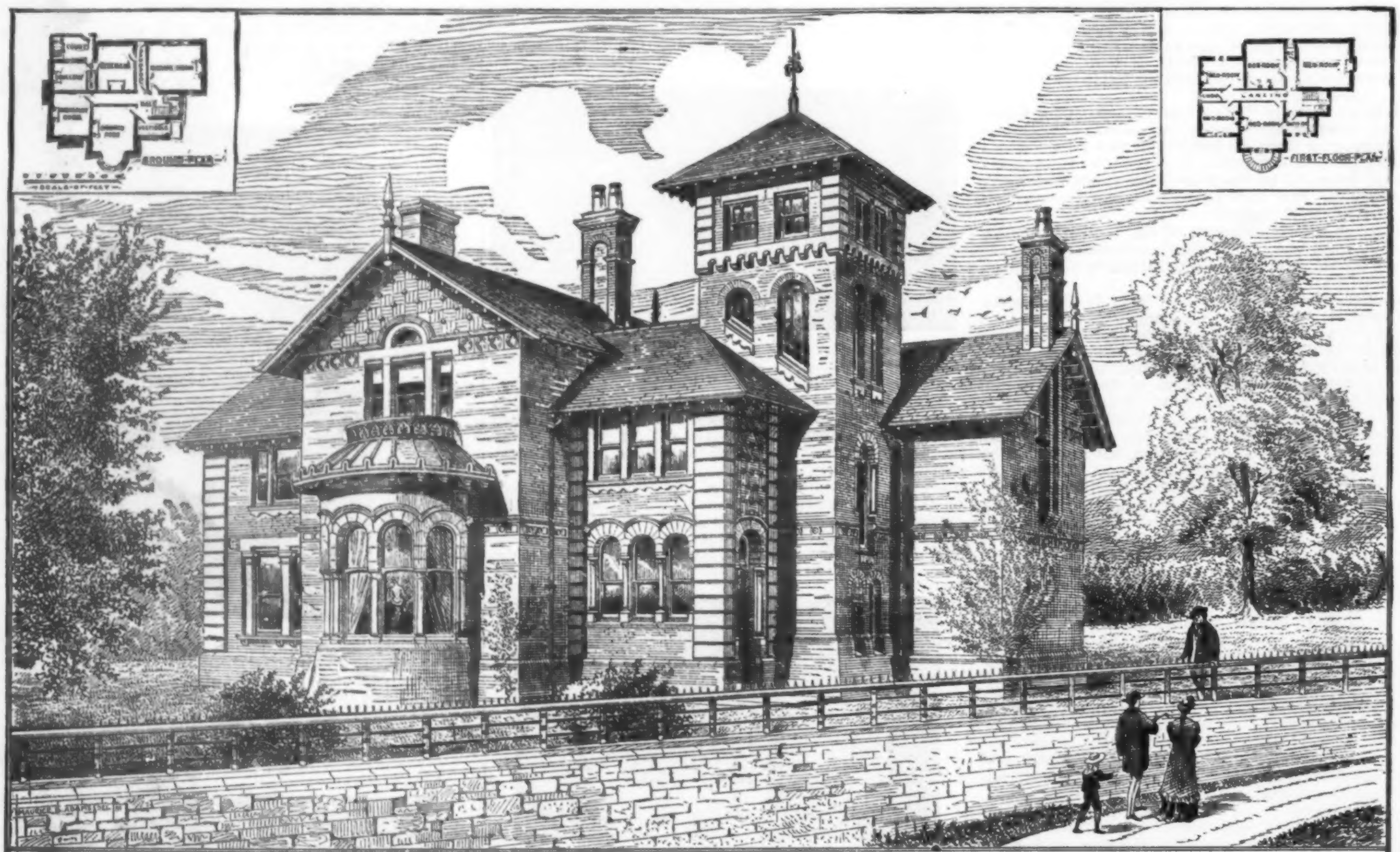
Frilling and blistering occur with many plates, and may be owing to the gelatine used being too soft, or the plate may have been over-polished, thus causing the non adhesion of the film in various places. The use of alcohol in the developer and fixing bath and the use of the alum bath tend in a great measure to reduce the chances of frilling.

A few days ago, when making a 12 × 10 negative, after fixing, the film swelled and left the glass. After a good wash I transferred it to a much larger plate. When finished I found it to measure about 13 × 15, quite even at the edges, and with no distortion of the image. The negative, in fact, was a perfect one, only several inches larger than was intended.

Gelatine negatives now being so extensively used by photographers, inquiries have repeatedly been made in order to ascertain the best means by which the negatives can be named or numbered, as the case may be, so that after they have been developed, and otherwise finished, they can easily be identified.

During the course of my experience I have found that this end may be attained in the following manner. It has been my custom to register the requisite number on the gelatine film, directly after exposure, with an ordinary lead pencil, which, it will be found, bites readily upon the surface of the plate; this marking is retained throughout all the various manipulations. By adhering to this method a number of sitters can be taken in rotation, and the developing carried on afterward without fear of the various sitters being mistaken for one another.

In an article by me a few months ago in the *Photographic Times*, I described a washing tank for gelatine negatives, such consisting, for the most part, of a box containing grooves made in a slanting direction of the size of the negatives used. Since its publication I have added to the one used by myself a piece of piping containing a number of small holes; this is affixed at the bottom of the tank, inside, the end of which protudes through the tank, so as to enable a piece of rubber piping being connected with the water faucet, the tank being allowed to overflow. This I find to be a very effectual manner of washing out all traces of the hypo.—*Photo. Times.*



RESIDENCE·MILFORD·MANOR·ESTATE·SALISBURY·FOR G. NODDER ESQ.RE JOHN HARDING AND SON: ARCHITECTS·SALISBURY·

HOW TO MAKE GOOD CIDER AND TO KEEP IT.

IN localities where the apple crop is abundant the preparation of cider for market is a profitable industry when intelligently undertaken, and there are few beverages more palatable and less harmful than cider when properly prepared. Unfortunately, there are few farmers who really know how to make good cider or how to care for and keep it when made.

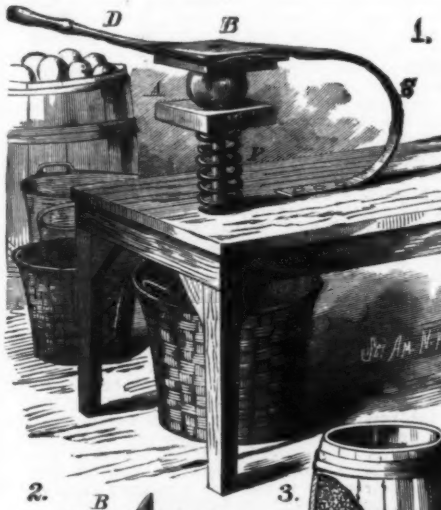
In the first place, apples not perfectly sound and well ripened are not fit for making cider. The russet is one of the best of apples for this purpose, but other and more commonly available varieties need not be slighted.

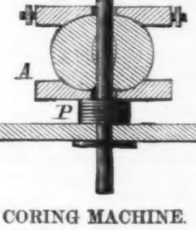
To prevent bruising the fruit intended for the cider press should always be hand picked. After sweating each apple should be wiped dry, examined, and any damaged or decayed fruit thrown out and used for making vinegar cider.

In the grinding or pulping operation the seed is often crushed and is apt to taint the juice, so that despite the loss and extra time required it is always better to core the apples before grinding them, as the cider will not only taste and look better but keep better. A cheap and handy coring machine is shown in Fig. 1. In this the coring tube, which may be of tin (free from iron rust), projects through a common bench or table, and is surrounded by an ordinary furniture spring, P, which supports a piece of wood, A. This has a hole in the center of it, over and partly into which the apple is seated. The lever, D, on which the piece of wood, B, similar to A, but having an aperture only large enough to admit the coring tube, is loosely hung by side pins, is held in position by the spring, S. The operation of the machine will be readily understood by referring to Fig. 2, in which it is shown in section.

All iron work about the mill or press (rings, rivets, etc.) should be tinned or coated with good asphaltum varnish, as the color and sometimes taste of the cider are apt to be affected by contact with the rusty metal.

In pressing the pomace many of the best cidermakers prefer to use hair cloth in place of straw between the layers, as it is more cleanly and does not affect the taste of or add anything to the expressed juice.





CORING MACHINE. FILTER.

As the cider runs from the press it should be filtered through a hair sieve into a clean wooden vessel capable of holding as much juice as can be extracted in one day.

Under favorable conditions the fine pomace will rise to the surface in about twenty-four hours—sometimes less—and in a short time grow very thick. Then it should be watched, and when white bubbles begin to appear at the surface the liquid should be drawn off slowly from a faucet placed about three inches from the bottom of the tank, so as not to disturb the lees.

The liquid drawn off should be received in clean, sweet casks, and must be watched. As soon as white bubbles of gas appear at the bunghole it must be drawn off (racked) into clean casks as before, and this racking repeated as often as necessary until the first fermentation is completely at an end. Then the casks should be filled up with cider in every respect like that already contained in it and bunged up tight. Many cider-makers add a gobletful of pure olive oil to the cider before finally putting in the bung and storing.

It it is desired to keep cider perfectly sweet—and this is rarely the case—it should be filtered on coming from the press, and then sulphured, by the addition of about one-quarter ounce of calcium sulphite (sulphite of lime) per gallon of cider, and should be kept in small tight full barrels. The addition of a little sugar—say one-quarter of a pound per gallon—improves the keeping qualities of tart cider.

An easily constructed cider filter is shown in Fig. 3, and consists in a barrel provided with a tap near the bottom. The lower part is filled with dry wood chips covered with a piece of flannel. Over this a layer of clean rye straw is packed down, and then the barrel is nearly filled with clean quartz sand, not too fine.

When the first fermentation of cider has been checked and the liquid barreled it should be allowed to stand until it acquires the proper flavor.

Much of the excellency of cider depends upon the temperature at which the fermentation is conducted. The casks containing the juice should be kept in a cellar, if possible, where the temperature does not exceed 50° Fah. When left exposed to the air, or kept in a warm place, much of the sugar is converted into vinegar and the liquor becomes hard and rough. On the contrary, when the fermentation is conducted at a low temperature, nearly the whole of the sugar is converted into alcohol and remains in the liquid instead of undergoing acetification. The change from alcohol to vinegar (acetous fermentation) goes on most rapidly at a temperature of about 95° Fah., and at a lower temperature the action becomes slower, until at 46° Fah. no such change takes place. Independently of the difference in quality of fruit used the respect of temperature is one of the chief causes of the superiority of the cider made by one person over that made by another in the same neighborhood.

The more malic acid and less sugar present the less the tendency to acetous fermentation; hence it often happens that tart apples produce the best cider. But cider made from such apples can never equal in quality that prepared at a low temperature from fruit rich in sugar, which, if properly cared for, will keep good twenty years.

When the first fermentation has subsided and the liquor has developed the desired flavor in storage it is drawn off into other barrels which have been thoroughly cleansed and sulphured, either by burning in the bunghole a clean rag dipped in sulphur, or what is better, by thoroughly rinsing the inside with a solution of bisulphite of calcium prepared by dissolving about a quarter pound of the sulphite in a gallon of water.

The isinglass—six ounces or more (in solution) to the barrel—should be stirred in as soon as transferred, and then a sufficient quantity of preserving powder of bisulphite of lime (not *sulphate* or *sulphide*), previously dissolved in a little of the cider, to entirely check fermentation. The quantity of this substance required rarely exceeds a quarter of an ounce to the gallon of cider. A large excess must be avoided, as it is apt to injuriously affect the taste.

Some makers sweeten their cider by additions, before fining, of sugar or glucose, the quantity of the former varying from three quarters of a pound to one and a half pounds, while as a substitute about three times this quantity of glucose is required. Sweetened cider, when properly cared for, develops by aging a flavor and sparkle resembling some champagnes. Such ciders are best bottled when fined.

The following are the methods by which some of the beverages found in the market under the name of "champagne cider" are made:

1. Cider (pure apple)	3 barrels.
Glucose sirup (A)	4 gallons.
Wine spirit	4 "

The glucose is added to the cider, and after twelve days' storage in a cool place the liquid is clarified with one-half gallon of fresh skimmed milk and eight ounces of dissolved isinglass. The spirit is then added and the liquor bottled on the fourth day afterward.

2. Pale vinous cider	1 hogshead.
Wine spirit	3 gallons.
Glucose, about	30 pounds.

The liquid is stored in casks in a cool place for about one month, when it is fined down with two quarts of skimmed milk and bottled.

Much of this and similar preparations are doubtless sold for genuine champagne.

3 Fine apple cider	20 gallons.
Wine spirit	1 gallon.
Sugar	6 pounds.

Fine with one gallon of skimmed milk after two weeks' storage in wood, and bottle.

POTATOES AND THEIR UTILIZATION.

ONE of the leading qualities of the potato is its extraordinary productiveness, far exceeding that of any esculent with which it can be placed in competition, one authority placing the yield from an equal quantity of ground at thirty pounds of potatoes to one pound of wheat.

In 1870 there were nearly one hundred and forty-four million bushels of potatoes produced in the United States, and certainly much more than that quantity will be gathered this year. In spite of the great market for this staple of food, it very frequently happens, especially in some of the extensive farming districts in our Northwestern States, where transportation rates are high, that overproduction so affects their value as to make the tubers unprofitable to handle, and, as a consequence, thousands of bushels of them are annually lost or thrown away.

In this connection we have been so frequently asked for what purposes other than as a food the potato can be utilized, that we will endeavor to answer the question.

Potatoes are composed very largely of starch and water, their average composition in northern latitudes being: Water, 75 per cent.; starch, 21 per cent.; albumen, cellulose, fat, and salts, 4 per cent. The water can be expelled by exposure to heat at a temperature of about 212° Fah., the residue having the composition: Starch, 83·8 per cent.; albumen, cellulose, fat, and salts, 16·2 per cent.

Nearly the whole of the starch can be separated from potatoes by simple and inexpensive mechanical operations, and as starch is a commodity for which there is always a good market, and as it can be stored for an indefinite time without danger of deterioration, it is obvious that potatoes may by profitably utilized in the production of starch.

The plant required to make marketable starch is quite simple and easily constructed by any intelligent farmer—a wire basket to wash the tubers, a rotary rasping machine, a few large tubs or watertight hogsheads, some wire and haircloth sieves, and a drying room, comprising the principal pieces.

A simple rasping machine is shown in Fig. 1, and consists of a band wheel, A, over the rim of which has been secured, rough side out, a piece of sheet iron previously roughed up like a nutmeg grater by punching it full of holes with a blunt-pointed tool. The wheel is mounted on an axle supported by the wooden frame so as to revolve immediately beneath the mouth of a metal-lined wooden hopper, B.

A more effective rasper or grinder is shown in Fig. 2. It consists of a cylinder, *c*, twenty inches diameter and two feet long, mounted on an axis. It is armed with steel saw plates placed about three quarters of an inch apart, parallel with the cylinder, and having small and regular teeth. The plates are held in position by iron clamps, so that the toothed edges project about four-fifths of an inch from the periphery of the drum. It is driven at the rate of about eight hundred revolutions per minute before the hopper, and is capable of pulping about forty-eight bushels of potatoes an hour. In both these machines the rasping surfaces are kept clean by the action of small jets of water projected with some force.

As the washed potatoes are passed through one of these machines the pulp and wash water is run off into tubs, and after the coarser particles have been deposited, the milky liquid is drawn off into other tubs and the starchy matter allowed to settle. Or, as in large factories, the pulp may be rubbed and washed through a series of sieves, ranging from coarse wire gauze to fine hair cloth. After repeated washings with fresh water in the tubs to separate the gummy and fibrous matters, the starch granules are finally allowed to settle, and after the water has been drawn off the pasty mass of starch and water is run off into long wooden troughs, slightly inclined, wherein the paste gradually hardens as the water drains off. When hard enough it is cut into blocks and put on shelves in a warm room to dry out. With good management from seventeen to eighteen pounds of clear starch can be obtained by these simple means from one hundred pounds of average potatoes, which could be disposed of in bulk at present prices.

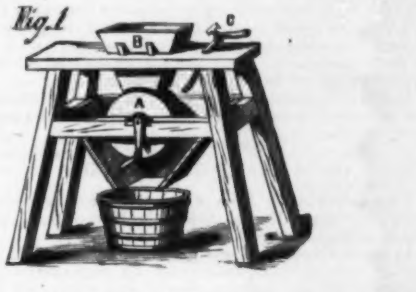


Fig. 1

Starch is not only used for "starching" and sizing fabrics and for various food preparations, but also for the manufacture of grape sugar, glucose sirup, gum dextrine or British gum, and alcoholic liquors. When gradually heated in the dry state to about 160° Fah., in a rotating cylinder similar to a coffee roaster, and kept at that temperature for a short time, the starch is transformed into a gummy substance called dextrine or British gum, soluble in cold water, and extensively used as a substitute for gum arabic.

When boiled for a few hours with water containing a small quantity of sulphuric acid it is gradually transformed into grape sugar or glucose—a kind of sugar extensively used by confectioners, brewers, distillers, and wine makers. The acid used is removed from the sweet solution by adding to it the proper quantity of chalk or lime, with which the acid forms an insoluble substance easily separated.

Fig. 2

Whisky can be made directly from potatoes. The potatoes, after being finely mashed with boiling water, are mixed with about five per cent. of malt, the diastase of which on standing converts the starch into grape sugar, one and one half or two per cent. of yeast is then added, and the fermentation allowed to proceed at a temperature of about 80° Fah., until the sugar has been converted into alcohol and carbonic acid. The alcoholic liquid when submitted to distillation yields whisky—one bushel of good potatoes yields about seventeen pounds of the liquor. The fermented potato mash can also be converted into a vinegar by allowing the fermentation to continue after the sugar has all been changed to alcohol, or more rapidly by passing the alcoholic liquid through an *Essigbilder* or quick vinegar apparatus. A cheap apparatus of this kind may be made from a large barrel, as shown in Fig. 3. The barrel is provided with a perforated false bottom at *a*, and a tight shelf at *b*. Birch shavings soaked in good vinegar are loosely packed into the space between the shelf and false bottom. The shelf is perforated with a number of small holes, through each of which is drawn a few strands of packing thread knotted at the top so as to loosely close the hole, *d d d*; in the figure are shown pieces of glass tubing secured in larger holes in this shelf

Fig. 3

Around the sides of the barrel, just above the line of the false bottom, are pierced a number of air holes. When a warm alcoholic liquid is poured over the upper shelf of this apparatus it gradually trickles down through the packthread and over the shavings, where it is brought into intimate contact with an upward current of air from the air holes below to the glass tube exit above, and is gradually changed into vinegar, which collects in the portion beneath the false bottom and flows off through the curved siphon tube, *g*. If the barrel is small it is usually necessary to pass the liquid through the apparatus three or four times before acetification is complete.

Recently a company has been formed in California for preparing (among other things) desiccated or dried potato. The drying is accomplished by passing a current of dry air, at a temperature of about 140° Fah., over the potatoes, cut in very thin slices, in kilns or ovens provided with a system of movable shelves. Doubtless a large demand for such an article would not be difficult to develop.

Boiled (dry) potato mixed with zinc chloride and barytes has been used to form an imitation alabaster and coral-like composition.

GAS AND GAS MAKING.

THE following is from a recent interesting address by President Samuel Dalziel, before the West of Scotland Association of Gas Managers, at Glasgow:

In the early days of gas lighting, Murdoch did his work quietly and philosophically, step by step, perfecting his apparatus for gas lighting slowly and surely, till he had made the illumination by gaslight of the workshop and of our dwellings an accomplished fact; and Clegg states of Winsor, the enthusiast, that "when his experiments failed he set to work again to make them succeed. When the persons he engaged to read his lectures neglected to keep their appointments, he made a good-humored apology to the audience. Whether the crowds in Pall Mall, who came to look at the gas lamps, cheered him while the lights were burning, or hooted him when they suddenly went out, he never lost heart, but kept on his course with as much earnestness as if nothing had ever gone wrong." These words apply with as much force to the men of to-day, who, in the midst of much to discourage, still persevere, and believe that electricity is the light of the future. It stands precisely in the same position to gaslight that gaslight did to candles or the oil lamp eighty years ago. Steadiness of the electric light is being slowly attained; its brilliancy is dazzling, and it will not heat apartments the same as gas. At present it is the attainment of a steady light and the reduction of the cost that engage the attention of the electrician. I noticed in the *Glasgow Herald* a statement by Colonel Festing, that the electric light is only one-fourth the cost of gas.

As yet we have the field to ourselves. Every part of the apparatus, from the retort to the gas-burner, has been vastly improved, so that we can tell what every pound of coal should produce in gas, and how many candles' light it will yield. There is no waste now, such as occurred in the early days of gas lighting, when the yield of gas was little more than half what it is now, when gas managers buried their tar out of sight as an unclean thing, and gas liquor was run to waste. These days are long past, and now every product of distillation has its value.

I believe gaslight will ever hold its own. Hitherto its chief use has been the illumination of our workshops and dwellings; and light for light, cost for cost, for steadiness and reliability, it will be with difficulty, if ever it can be, surpassed. No other light has ever been so submissive to our commands. It is ready to blaze forth at the command of a child, or submit to be kept down to the tiniest spark. There are many other uses to which it is being applied, and I believe the time is rapidly approaching when every house will have its cooking-stove, and when gas will be the motive power employed to brush our boots, clean our knives, etc. In one large establishment in Edinburgh the motive power for the printing-press is the gas-engine. In Kilmarnock there is the same, besides other uses to which gas is applied; and it is not unlikely that gas may be the motive power to make electricity outshine himself. If we are to prevail and hold our own, we must apply ourselves with greater diligence to master the details of our profession, such as the selection of coals, the erection of retort-benches, the generation and purification of gas, and its distribution, from the holder up to the burner. This latter department—especially the burners—is occupying the attention of many scientific men, with very favorable results. Mr. Sugg, Mr. Bray, and others, have done and are still doing much to show that, as an illuminant, gas is capable, with their improved burners, of yielding much more light than has hitherto been obtained from the quantity of gas consumed, and that when employed with proper burners it will not be easily driven from the field. There is also the hitherto neglected department of residual products—the tar and liquor—the manufacture of which will eventually, I believe, become a department in every gas-works.

Mr. T. Newbigging, C. E., in his "Gas Manager's Handbook"—a practical work on gas which every gas manager should not only possess but consult frequently—has laid down four "Golden Rules for Gas Managers." I would call them the four "keeps," wherein lie the strength, power, and prosperity of every gas company—the strongholds behind whose walls lies the power of resistance, as well as making us strong to attack, and in which, if we use judiciously the means at our command, gaslight will hold its own against all comers and against any attack, however brilliant. These "keeps" are—(1) "Keep up the heats of the retorts." (2) Keep up the water in the meters. (3) Keep down the pressure in the mains during the daytime. (4) Keep down the arrears in the gas ledger." In regard to the first "keep"—"Keep up the heats of the retorts"—this implies that we have the power to do so. In such an association as ours, many members are managers of small works. To such, one of the first considerations in the purchase of coals should be the quality of the coke; because, if we have not a coal with good coke to give us heat, a coal otherwise good may be simply wasted; as without good heats, rich coals, instead of being converted into gas, are distilled into a rich tar, which, with good firing material, would otherwise have formed the products of distillation into incondensable gases. If we have a good coke there will, as a rule, be a good return of gas. Another point in purchasing is to see that the coal is one of light specific gravity, because it is more easily distilled, the charge being worked off in much less time than with a coal that is heavy; the former parting with its gas readily, and the latter only when the heats are high. This is a point that should be looked at carefully in small works, because generally speaking the heats are never so high as when there is continuous working. I could refer particularly to one coal, which when fired with its own coke, only gave 9,000 feet of gas; yet the same coal when worked with a coke of good quality gave 10,400 feet, thus showing the importance of a good coke.

Another consideration is the retort-bench. If it is badly constructed, no matter how good our firing material may be, no amount of labor will ever bring or keep up the heats. I know one gas-works where the heats pass direct to the chimney—merely passing over, but not under the retorts as well. I know another works where there was a setting which had an arch above the fire, longitudinal flues above and under the retorts—in short, so much brickwork in the setting, that the draught was all but choked, and no amount of firing could ever overcome it, or raise the heats to a bright red; yet the manager believed his setting was perfection itself. In theory he was right; but in practice it failed, because the power of the draught was broken. The setting was built by himself, and he was quite satisfied with a make of 5,500 feet per ton of coal. In the first case the manager erred from the want of flues; in the latter from having too many. In building a retort-bench I believe in having a good-sized oven internally, and as little brickwork as possible, compatible with a solid resting-place for the retorts. If for one retort, it should have a nine inch wall next the fire, and no other brickwork than is sufficient to carry the retort and give direction to the draught. This applies to two or more retorts. In no case would I have more building than could carry the retort; by so doing a good heat will be obtained, the heats will be even from front to back, the retorts will be easily fired, there will be less work for the fire to do, and the draught will not be intercepted by brickwork. More brickwork than is absolutely necessary in an oven implies a waste of fuel and harder work for the stoker.

As to the form or plan of setting retorts, the methods are various. Each should try for himself, and discover the setting from which the best heats can be obtained. If we have a bad setting, no amount of labor will enable us to get the heats; while with a good setting, if we are so fortunate as to get the heats higher than desirable, an extra charge will bring them down to the required point. There is one matter on which we cannot go wrong, and this is to have good thick external walls. The thicker we have these, the better it will be for us. My own are eighteen inches, and it is of much advantage to pile up bricks nine inches thick. In addition to this, and even with it, I have had coals kindled that lay against the wall. This shows how much heat is lost by radiation.

In the *Journal of Gas Lighting* recently I noticed an article by M. Melon on the "Economy of Heat in Carbonizing Furnaces," in which it is stated that only 11 per cent. of the heat developed is utilized; and that the common retort setting, as at present constructed, is an extremely imperfect apparatus as regards the utilization of heat. M. Melon makes out that we have the following percentages of loss: By the chimney, 60; products, 17; casing, 2·5; radiation, 1·5; furnaces, 2·5; sundry losses, 5·5—total, 89 per cent. of loss. Here is a fine field for the ingenious. If only 50 per cent. of the heat developed could be utilized, what an amount of profit we should have from this source alone! Dr. Siemens is, I think, upon the right track; and eventually, when coke becomes of more value, his system will be the order of the day. I find it is very beneficial to frequently whitewash with lime and fire-clay the fronts of the ovens, as it makes the retort-house much cooler for the men, and assists in conserving the heat. It is a common saying that "dividends are made in the retort-house." The furnace is the stomach, the retorts the heart. Keep them right, and satisfactory results are sure to follow. Attention should also be given to the stoker, in seeing that he does his duty; not only that he keeps his fires in good order, but also that he keeps his retorts clean—scurfing them frequently to keep them free from carbon—and that the charges are not too weighty, for it is no profit to put in heavy charges. My own experience is that light and short-time charges will produce more and better gas than heavy charges and coals lying a long time in the retorts; besides, it is necessary that there should be a clear space above the coals to allow the heat to have access to the gases when generated, so that they may become of a permanent nature when cooled down.

The next "keep" which I shall notice is the third—"Keep down the pressure in the mains during the daytime." I will also add, "Give no more pressure at night than is necessary." The holder is the lungs, the main and service pipes are the arteries and veins of a gas-works. Premising that a gas manager has all that he could desire in regard to heats, that he has a good return per ton of coal carbonized, of what avail is it if the distributing apparatus is bad—if, with high pressure day and night, what is made in the retort-house is dissipated in the mains? Nature herself will not permit gases to remain quiescent. The moment any gas is generated, a struggle at once begins for a change of place. What chemists call the laws of exosmose and endosmose are continually exerting an energetic influence in the displacement and replacement of one gas with another. This is shown in the dead gas in a pipe from which there is no consumption; and it is in the daily experience of those who turn off their gas at the meter, that what they call the foul air must be blown off before the gas will light. All pipes are more or less porous, in proportion to the density of the metal—cast iron, malleable iron, or lead, the last being the closest in the grain. This interchange with the air outside goes on continually in a greater or less degree, and leakage proceeds in proportion to the density or quality of the material employed. I do not believe the leakage in mains and service-pipes, if there is any length of them, can ever be reduced below 8 or 10 per cent. I tested this for some months on a 3 inch main-pipe, 1½ miles in length, on which there were only 12 consumers, and the leakage was 11 per cent. In this case I believe the pipes were all sound, and at no time was the leakage under 10 per cent. In another works which were built on a hill, a day pressure of 20-10ths was kept up, and at night 32-10ths. The former was reduced to 13-10ths, and the latter to 24-10ths; the result being that at the end of the year the sale of gas had increased 500 cubic feet per ton of coal carbonized, and this has been maintained ever since. Besides this there are now fewer complaints of the quality of the gas. Do not spare expense in keeping the distributive plant in good condition, as in a very short time as much gas may be allowed to escape as would pay for the repairs—nay, even for new pipes altogether. If we only consider how small is the opening through which four feet of gas per hour will escape, we shall perceive that such an escape, going on constantly, will soon sum up to a good round figure. If there should be leakages, the more necessary it is that the pressure be kept at as low a point as will satisfy the demands of the consumers. If you would prosper, I say keep down the pressure, not only during the day, but also, as far as practicable, during the night.

The next "keep" I shall notice is, "Keep up the water in the meters." No gas manager should require to be told this; yet there are many managers of small works who water their meters only once a year—viz., at the beginning of the season—others twice a year, and consider that they do their duty. Others, again—and I believe they are right—water their meters every six weeks or two months. My own practice and instructions to the surveyors are that the meters should be watered every two months. If they are carefully attended to, it is not much they require; yet there always are a number that need more water than the average, and these are attended to every month. This arises from the position in which they may be placed—either near a fire or in a warm room. Evaporation is constantly going on, and as the range is only 5 per cent. between the meter being drowned and the gas going out for want of water—that is, 2 per cent. in favor of the company, and 3 per cent. in favor of the consumer—it shows that there is a necessity for regular and systematic watering of wet meters. It may be expected I should say a word on dry meters. Well, my experience is such that I would have nothing to do with them. If there is a large consumption through them they do well; but if the consumption is small, say 2 or 3 feet per hour, they will not indicate this quantity. I have lately taken off a few for this reason. Above 3 feet per hour they worked correctly; but under this there was no indication. If I had to consult my own will only, I would not have a single dry meter, but keep wholly to the wet, as the most reliable instruments between buyer and seller, to give a true indication of the gas consumed; but this implies that they are properly attended to, and that the water is kept up in the meter.

The last "keep" is, "Keep down the arrears in the gas ledger." It is said that "money is the sinews of war;" so let us look after it. "Short reckonings make long friends;" therefore let us be friendly with our consumers. When I began to collect, the advice given to me was to "keep at it; call again and again; always be civil, and never lose or show temper." This applies to every department of business. Happy are they who are constitutionally of a quiet spirit. If there is one occupation more than another in which patience, perseverance, and urbanity are required, it is the collection of gas rates. It is then that our sins of omission and commission are remembered against us, and it is then that the "soft answer turneth away wrath." There is a proverb that "speech is silvern; but silence is golden." An old friend of mine has often told me that he has regretted speaking, but he never regretted holding his tongue; therefore to those gas managers who collect their own gas-rates, if they would keep down the arrears in the ledger, the frequent call will generally overcome those who are apt to give trouble. To some these remarks may appear unnecessary; yet it is by repetition that the lesson is learned.

At no time since the introduction of gas lighting as an industry has it accomplished so much as it is doing now. Gas was never so pure, never so good, and never so cheap as at the present time. It is being turned to a greater variety of uses now than ever before; but we, as gas managers, have been content only to manufacture gas. I think we ought to go further. We have lately begun to realize this since competition has come into the field; but I believe, if we only took the trouble to show our customers the variety of uses to which gas can be put, there would be a much more rapid and general increase in the use of gas over the whole country. I have no fear that gas will ever be displaced; but it cannot be a pleasant thing for any man to see his largest and best customers using another light. It should be the duty of every manager to keep, and show occasionally, the best burners, the best cooking-stoves, gas engines—in short, everything that would lead to the best uses and application of gas to our every-day necessities. If this were done, gaslight would ever stand superior to any other light, and there would be no fear of the day coming in which we may require to put on bands for our own burial.

ON THE SPECIFIC GRAVITY OF NICOTINE AND ITS BEHAVIOR WITH WATER.

By J. SKALWEIT.

THE statements in regard to the specific gravity of nicotine differ considerably—a fact which is surprising when we come to consider the great number of thorough investigations which have been made on this alkaloid.

Gorup-Besanez ("Lehrbuch d. org. Chemie," 1876, p. 696) gives the specific gravity of nicotine as 1·048. The same figure is given by Fittig (in "Woehler's Grundriss der Organ. Chemie," 1872, p. 403), and also by Dragendorff ("Die Gerichtl. Chem. Ermittelung von Giften," 1876, p. 245). A. Naquet ("Principes de Chimie," 1867, tome ii., p 455), on the other hand, places it at 1·033 at 4°, and in this determination G. Gottlieb agrees ("Lehrb. der Pharm. Chemie," 1859, ii., p. 415). Herm. Hager finds the density of pure nicotine to be 1·022 to 1·024 ("Manuale Pharm.," ii., p. 417).

During the past few years, the author has had occasion to make many hundreds of nicotine determinations. Having by working with an apparatus (invented by Ernest Abenderoth) for secondary fermentation, obtained large quantities of nicotine, he, in addition to his other work, determined exactly the specific gravity of nicotine. He found from a mixture of

100 grms. nicotine with	5 grms. of water	a sp. gr. of	1·017
"	10	"	1·024
"	20	"	1·030
"	30	"	1·034
"	40	"	1·037
"	50	"	1·040
"	60	"	1·038
"	70	"	1·033

Nicotine, therefore, exhibits a physical behavior similar to acetic acid, whose density likewise increases by the addition of water from 1·0533 to 1·0748, and does not return to its original gravity until 60 per cent. of water has been added.

Such a peculiar phenomenon leads one to suspect that, in all probabilities, an entire series of substances possessing like characteristics await investigation in this direction.

It would also appear that the specific gravity of coniine increases by the addition of water. The small quantities of this body, however, which were at the author's disposal prevents his giving any definite figures as yet. Of course, both the nicotine and the coniine used in these investigations were previously analyzed and their strength determined by normal sulphuric acid. When their absolute purity had been definitely ascertained, the mixtures with water were made, cooled, and examined.—*Berichte der Deut. Chem. Gesell.* xiv., p. 1810.

A HILL OF MAGNETIC IRON IN MEXICO.

A MOST remarkable bed of this ore has been discovered in a hill on the estate called Palmar, belonging to Don Conrado M. de Castro, in the township of Tepuche, about twelve miles northeast from Culiacan. An invitation having been extended to the subscriber—together with the governor, the chief justice, and other persons of note, by Mr. Edward P. North, superintendent of the Sinaloa and Durango Railway, who, on his part, was invited by the owner to make an inspection of the vein—we set out on the 18th instant (September) for the locality in question. From Tepuche we struck east, leaving the rancho of Palmar to the right, and in a short while we had begun the ascent of the hill itself, which appears to be one of the first rises on the ridge of Tachinopla. At every step, and covering the entire western slope which we were mounting, there could be seen numberless black, glistening masses of rock breaking through the fold of vegetation.

It was not long before we recognized their mineral qualities; for having detached some pieces with a hammer, we tested them with a small compass, the oscillations of which established beyond question the presence of the metal. Once up there was nothing to be seen but blocks of the blackest hue, which, in a thousand different shapes, started up all over the rounded summit, which is throughout of the same black color, being one mass of magnetic rock. It was plain at once that the body of the mountain was composed of the same mineral substance, or at least that its enormous top was the head of an immense vein of iron without end or limit. Mr. North found by means of the aneroid that the hill has an altitude of 290 English feet above the level of the stream skirting its base. On the hypothesis that it was a cone approximately regular, with its sides inclined to the horizon, say, thirty-five degrees, he found that it ought to contain more than fifty-two millions of cubic feet of ore, to say nothing of the immeasurable quantity existing below the plane of its base.

On the same estate there are other hills presenting the same marks of mineral deposit, which we were unable to test for lack of time. We found also a limestone hill, from which can be had all the lime necessary for working the ore. It is said that some specimens that were taken from the hill in question and treated in the mint, have given a yield superior to that of the ores of the hill of Mercado, in Durango. The specimens obtained on our visit have been sent on to the United States; all of them, without exception, attracted needles and small pieces of iron that were brought into proximity with them. When the railway from Altata to Culiacan, which is in process of construction, is extended to Durango, it will pay to have the line take a slight turn to the north, so as to touch this hill, which might furnish the rails for the continuation of the road from that point, and which is destined one of these days to supply both the foreign and domestic market, because of its proximity to the sea, from which it is not more than seventeen leagues distant.—*Mexican Correspondence Boston Advertiser.*

SCHUYLKILL COUNTY ANTHRACITE.

A DESCRIPTION of the geological formation of Schuylkill County, Pa., has lately been published by Prof. Sheafer, of Pottsville, Pa.

Schuylkill County, which is one of four counties from which is sent about nine-tenths of all our anthracite, is described as a mountainous area of 767 square miles, situated easterly and southerly from the center of the State. The summits of the mountains are from one thousand to seventeen hundred feet above tide, disposed in irregular ranges and cut through in many places by narrow, steep-sided, and rocky defiles. Through the only practicable pass in Kittatinny or Blue Mountain, which forms the southern boundary of the county, flow the waters of the Schuylkill River and canal, and the traffic of the Pennsylvania and Reading Railroad. The drainage of the county is into the Schuylkill, Susquehanna, and Lehigh rivers.

The geological formation of Schuylkill County is confined to the Silurian, Devonian, and Carboniferous ages of the Paleozoic system.

The most notable of these is the deposit of the more recent or carboniferous age, containing the most important coal measures of the State.

No less than thirty veins of coal, fifteen of which are workable beds, lie interstratified with rocky deposits to a depth of three thousand feet, resting on a conglomerate stratum called by Prof. Rogers *seral*, and by Prof. Lesley *Pottsville conglomerate*, while it is known on the other side of the Atlantic Ocean as *millstone grit*.

It is considered an important formation—the protecting barrier that has saved these remarkable anthracite beds.

The workable beds of coal vary in thickness from three to twenty-five feet, together making a total of one hundred and seven feet of available coal deposit.

The five upper strata contain a total of thirty-four feet of coal in beds from three to seven feet thick, all of which is red-ash. Then comes a bed of gray-ash ten feet thick, followed by five beds of white-ash, from five to twenty-five feet thick, making a total of 52 feet of this kind, and, finally, two beds of red-ash, free-burning coal, a total of eleven feet more to the bed rock. This last red-ash is known as Lykins Valley coal, and it is much valued for domestic purposes.

The product of the Schuylkill County mines for the year ending June, 1880, was seven and one-third million tons of anthracite, over one-fourth of the total output of Pennsylvania anthracite for that year.

The SCIENTIFIC AMERICAN of Sept. 17 contains full statistics of the American anthracite industry, which show that enough remains untouched to last 146 years at the present rate of mining. A greater quantity than the estimated 4,000,000,000 tons might be made available if methods could be adopted to save the two-thirds that are now practically wasted in pillars to support the roofs of the mines, and in dust and dirty coal arising from the processes of mining and preparation for market.

GEOLOGICAL CHART;

Including the Rock Scale of Geological Periods and the "Zoic Calendar of Creation." Compiled from the works of Agassiz, Lyell, Huxley, Haeckel, Dana, LeConte, and other first rank authorities in Science at the present time. By HIRAM A. REID, Secretary State Academy of Sciences at Des Moines, Iowa. [Published by permission of the Author.]

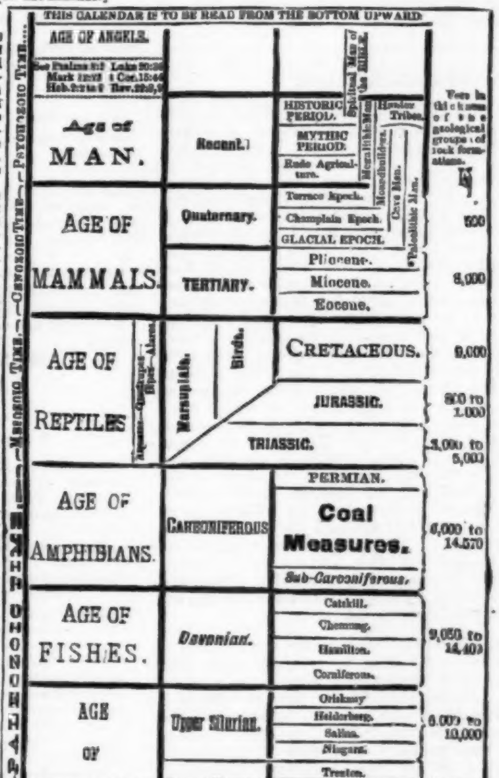
EXPLANATION.—The side line at the left shows what portions of geological time are comprehended in the terms "eozoic," "paleozoic," etc. The first column shows the periods or "Ages" of geological time during which the different successive types of animal life predominated, or were the highest types then in existence. And these two divisions form the "Zoic Calendar of Creation."

The second column shows the great general groupings of rock strata in which are found the fossil remains of the corresponding animal types named in the first column. But, at the "Age of Reptiles" occurs a grand divergement, for it was during this age that animal life pushed out into its most wonderful developments; and there came into existence strange and marvelous forms of swimming reptiles, four-footed and two-footed walking reptiles, and two-footed and four-footed flying reptiles. Here also the true birds began to appear, though with reptilian peculiarities; and likewise the marsupial animals, which are a transitional type, between reptiles that produce their young by laying eggs and the true mammals, that bring forth their young well matured and then suckle them.

The third column shows the lesser groupings of rock beds as classified by our American geologists; but many minor subdivisions and local groups are omitted for want of space. At the top of this column are shown the geological periods of first appearance of races of man, so far as now authenticated by competent scientific authorities.*

The fourth column shows the number of feet in thickness of the different groups of rock layers as indicated by the braces.

This Chart is the most comprehensive and thorough in its details, and yet the most systematically and graphically presented to the eye, of anything in its line that has ever yet been published. Here is the whole story of geology and the ascent of life condensed into the space of a few inches, yet so plainly set forth as to readily fix itself in the memory like an outline map. Scientific terms in newspapers and magazines often catch the reader at a disadvantage; but a reference to this chart will at once show the relative place or period in creational progress to which the oft unnoticed geological terms apply. It reaches, like a Jacob's ladder, from the lowest inklings to the highest ideals of life on the earth, as taught by modern science and the Christian Bible.



* "The existence of Pliocene man in Tuscany is, then, in my opinion, an acquired scientific fact."—See Appletons' International Scientific Series, Vol. XXVII, p. 151. "The Miocene man of La Beauce already knew the use of fire, and worked flint."—Ib. p. 343. See also, Prof. Winchell's 'Pre-Adamites,' pp. 426-7-8. "The human race in America is shown to be at least of as ancient a date as that of the European Pliocene."—Prof. J. D. Whitney. Similar views are held by Profs. Leidy, Marsh, Cope, Morse, Wyman, and other scientists of highest repute.

AMERICAN ARCHÆOLOGICAL EXPLORATIONS IN ASIA MINOR.

A SPECIAL meeting of the Archæological Institute of America was lately held in Boston, for the purpose of hearing reports concerning explorations in progress under the sanction of the institute in Asia Minor and in Mexico. While as an American organization the institute may be said to be more intimately concerned in the antiquities of this continent, the predominant interest at this meeting was directed rather to the report from Asia Minor, and this because of the gratifying success said to have attended explorations made there during the past few months. The president, Professor Charles Eliot Norton, occupied the chair, and made a statement in explanation of the results achieved, and read a paper in the nature of a report from Mr. Joseph T. Clarke, chief of the exploring expedition, and also a letter from him dated October 10. The letter was written at the scene of exploration, the ancient Greek city of Assos. From these it appears that the excavations at Assos have brought to light ancient sculptures of the highest artistic value and in admirable preservation, and have added important and indubitable information to the meager facts hitherto ascertained of the architecture of the chief temple of the old city. This temple is one of the earliest of the Greek temples of renown. Its site has been substantially known to modern students, though the structure was destroyed at a remote date, of which there is no record. The demolition is supposed to have been caused by an earthquake, for the site not only of the temple, but the whole city, is a confused mass of ruins. The only explorer of note who has visited the place and made any record known to modern times was Texier, a Frenchman, who, being commissioned therefor by the French Government, went over the whole of a large part of territory of historical interest in Asia Minor in 1834–37. So far as the site of the Temple of Assos is concerned, it now is shown that his examination was cursory, and his reports relating thereto either quite erroneous or very misleading. He did, however, obtain from the place and ship to France some very interesting sculptures and the frieze of the temple, seventeen in number. These were deposited in the Louvre, where they still remain, and are among the most valued treasures of its museum of ancient art. So imperfect, and, as it now appears, conjectural, were Texier's written reports concerning the temple that they have brought only confusion to students of art, and, instead of enlightenment upon the earlier Greek architecture and sculpture, have produced insoluble problems.

The gain to historical knowledge and to art through what has now been done is twofold. First, the site of the temple and the dimensions of the structure have been ascertained with entire accuracy, through the uncovering of the floor to a sufficient extent to prove by measurement its exact length and breadth. In the removal, with the *débris* of the blocks of stone which constituted the building, the floor-space laid bare shows that the floor was paved in mosaic, and what architecturally is of more importance, shows the exact position, indicated by the builders' marks, of eighteen of the columns of the temple. Under the critical observation of the experts appointed by the institute, the various blocks which were thrown out were readily recognized, and enough of them that are quite perfect were obtained to demonstrate what was the construction of the temple in all its architectural members. As the Greeks are known to have rigidly adhered to certain proportions in their building, not only as respects the main features but the minor features, it will be quite possible to restore the temple in model and present it to the eye in a manner to meet the criticisms of the most punctilious. In the second particular, the gain is in great superiority of the sculptures now exhumed in respect to their state of preservation in comparison with those of the Louvre museum. The specimens sent home by Texier were undoubtedly such as lay upon the surface, where for centuries they had been exposed to the action of the weather. The blocks of stone now brought to light were not, or at least these much-prized sculptures were not, found lying as they fell in the earthquake shock. Twice in later history—once in the Byzantine period, and later in the period of the Genoese domination—the place has been occupied as a fort. The site of the temple was the Acropolis of the city, or the summit of the hill on which the whole city was built. The hill faced on one or more sides upon the sea, and the position was thus very defensible against military assault. For building the fort the blocks of the fallen temple were used, and in the wall construction of the fort they were embedded in mortar. For convenience in laying or for making a better face to the wall, the sculptured surfaces were laid inward. Thus they have remained impervious to the elements, and when now brought forth and cleared of the mortar, present the sculptured work sharply defined and substantially as it appeared when the temple stood. Thus, as a contribution to the souvenirs of Greek art in its infancy, while it yet showed traces of the influences of Eastern art out of which it sprang or which historically preceded it, these sculptures are regarded by at least some of those concerned with real enthusiasm. Some specimens of this work will undoubtedly find place eventually in the Museum of Fine Arts in this city. The work of excavation is carried on under a permission or "firman" granted by the Ottoman Government, wherein a certain proportion of the relics of value found are to be at its disposal. But about half the floor area of the temple is yet cleared, and it is reasonably expected that other equally valuable sculptures will be met with. No recoveries of statuary are looked for, as it was one of the practices denoting the barbarism of the peoples who succeeded the Greeks to use all marble, rough or sculptured, for burning into lime. The stone of the frieze on which the sculptures in relief are found is a gray volcanic trachyte. Seven sculptured blocks have thus far been obtained. Other places of great prospective interest for the purposes of excavation on the city territory are the site of the theater and the stoa, or covered promenade, and place of exchange. The territory which was once thus built over as a city, and which is yet marked by superincumbent ruins, is of several miles extent.

The representatives of the institute in this enterprise are Mr. Joseph T. Clarke and Mr. Francis H. Bacon. Both of them are graduates of the Institute of Technology in Boston, and Mr. Clarke has studied also in the Architectural School of Munich, and enjoys the acquaintance on familiar terms of several of the eminent German archæologists. One pleasant proof of this is in the circumstance that as these excavations at Assos were begun at about the same time that excavations by a German party at Pergamon were ended, the latter transferred their tools and machinery without charge to the American party. The story of the experience of Messrs. Clarke and Bacon in this enterprise is in many particulars a romantic one. Their earliest exploration or reconnoissance, which was preliminary to determining a place for excavation,

was made in a small yacht along the Asia Minor coast. To obtain a proper vessel they purchased one in England and freighted it across the continent to the Upper Danube. Thence they sailed down the river, being shot at on one or more occasions by natives living on the banks, but reaching in safety the Black Sea. Over its rough waters they continued their course, thence through the Bosphorus and the Dardanelles into the Ægean Sea. Returning to America last winter, their representation of the possibilities of the region in archæological particulars enlisted the co-operation of the institute and other active friends of historical investigation in this line. The result, as already stated, was the eventual obtainance of a firman from the Turks. The knowledge and skill of the two gentlemen named are well attested in the success which followed the first experiment in excavation. As preliminary to this a careful survey of the adjacent territory had been made, and it was judged upon such data, ancient or modern, as were available, that a particular spot was preferable for sinking the first pit for reaching the floor of the temple. It was a happy surmise as to the right spot, for the workmen reached at the bottom of the pit the very entrance steps of the temple. The name of the temple is unascertained, but what has been gathered indicates that it was known as "the temple of the undefiled one," and it is therefore surmised that it may be the temple either of Minerva or Diana. It is of the Doric order of architecture. Its dimensions are identical with those of the temple of Theseus at Athens, but it is believed that the Athenian structure is of much later date. The work of excavation was begun in August last. The firman permits of its continuance till the year 1883, and it is the desire of the gentlemen who have thus far sustained the enterprise that further contributions shall be made sufficient for its thorough prosecution, for this among other reasons, of the fame it will bring to the archæologists of America.

Another report made to the meeting through Mr. Francis Parkman related to the explorations of Mr. A. F. Bandelier near the city of Mexico. He contemplates the exploration not only of Old and New Mexico, but of Central America and of Peru. Mr. Parkman urged the desirability of Mr. Bandelier being enabled to continue the work that he had begun. The Rev. E. G. Porter, of Lexington, followed with some remarks very complimentary to Mr Bandelier, based upon information which he, Mr. Porter, had obtained during his sojourn in New Mexico since Mr Bandelier made his explorations of that country. The governor and other eminent citizens are very much interested in the matter and greatly applaud the explorer. Mr. Stephen Saulsbury, Jr., of Worcester, also spoke in cordial praise of Mr. Bandelier's work. Mr. Phillip H. Sears expressed his gratification at the success which has attended the past year's enterprises of the institute, and proffered his contribution of $500 to promote that of the year to come.

ON THE FORMATION OF THE TAILS OF COMETS.

By M. FAYE.*

IN the *Comptes Rendus* of June 27, I read, not without surprise, a note by M. Flammarion, in which the learned author throws doubt upon the materiality of the tails of comets, and the existence of the repulsive force which produces them, a force the principal characters of which were formerly indicated by me.

It is curious that these denials appear in the same number of the *Comptes Rendus* as the spectroscopic observations of MM. Huggins, Wolf, and Thollon, which show in the analysis of the light of the present comet the superposition of two spectra, evidently due to the presence of material molecules, some reflecting the light of the sun, the others also emitting a light of their own. Moreover, this is what spectrum analysis has proved for all comets, without exception.

The argument upon which M. Flammarion depends recurs to the idea that the comet carries its tail as a sort of brush continuous with itself. He concludes that the extremity of this brush must sweep through space with the frightful velocity of 16,000 leagues per second; and, in consequence, the above-mentioned brush is not a body, but an appearance, a sort of luminous phantom, due to the excitation of the ether situated behind the comet.

This is due to a misunderstanding of one of the greatest scientific problems of our epoch. There is not an astronomer who believes that the tail of a comet is a rigid whole attached to the nucleus: one might as well imagine that the smoke of a steamboat that started from Havre, and that one sees arriving at New York, has crossed the Atlantic with the vessel. It is two centuries since Newton explained these matters by showing that each section of the tail taken at a given moment was abandoned by the head at an antecedent period—a period more distant in proportion as the section itself is further removed from the nucleus. Each of these sections has followed, in space, an orbit absolutely different from that of the head of the comet; and the tail, in its entirety, is nothing but the envelope of the positions occupied at a given moment by the series of puffs of cometary matter successively emitted and driven off on the preceding days, without there being between them any other connection than the velocity of translation which they possessed in common at their points of departure.

Calculation applies perfectly to these singular but by no means mysterious phenomena. Bessel furnished their formula, which enables us to determine by the curvature of the tail the intensity of the force that produced it. Quite recently, M. Bredichin, director of the Observatory at Moscow, has obtained from it most interesting results.

As to this force which M. Flammarion denies, although in every comet we see its effects marked in the heavens in gigantic features, it is certain that matters go on as if the sun was endowed with two actions—one attractive, belonging to its mass, the other repulsive, due to its electric (Olbers), magneti-polar (Bessel), or calorific (Faye) state. We may dispute its essence, or its physical nature, but not its mechanical characters as I have defined them, because these characters result from the observed facts, namely:

1. This repulsive force is not proportionate to the masses, like attraction, but to the surfaces. Hence it produces the more marked effects in proportion as the matters subjected to it are less dense.

2. This force is not exerted through all matter, like attraction; it is, on the contrary, weakened, or even arrested by the interposition of the smallest screen.

3. It is not propagated instantaneously, like attraction, but gradually, like light and heat. It results from this that its action upon a point in motion is not exerted in the same direction as attraction, even though the two forces emanate from the same body.

4. Lastly, this force varies inversely to the square of the distance, like the intensity of light and heat. This is the sole point of resemblance between the two forces which the sun exerts simultaneously upon all bodies, one which is connected with its mass, and therefore invariable, the other with its physical condition and consequently transitory.

This latter force necessarily affects the planets and their satellites as well as the comets. The first of the four characters that I have just indicated will explain how its action upon the planets, which are of incomparably greater density, has hitherto escaped the notice of astronomers. It is a problem reserved for a comparatively near future.

It is exerted also upon our planet at the boundaries of our atmosphere, but its meteorological effects are masked by those of solar radiation, which is much more powerful, and the period of which is exactly the same. I have at least endeavored to demonstrate its presence around us by the action of incandescent laminæ upon very rarefied matter, which I rendered visible by means of electrical currents. In this great difficulties are met with, which will not surprise any one who considers the trouble it has taken to compel even attraction to manifest itself about us between neighboring bodies. . . .

In conclusion, I would indicate that the simultaneous existence of several tails, with very different curvatures, is one of the most striking verifications of the characters above assigned to the repulsive force. These multiple tails are not exceptional, as was formerly supposed; their presence is a fact which tends to become generalized as comets are observed with very powerful instruments. It is true that the present comet seems to have only one, but this is no doubt due to our being at no great distance from the plane of the orbit, the plane in which all the tails are formed, so that, so far as we are concerned, they are projected one upon the other. It is for the same reason that the tail of the present comet is apparently straight. If, instead of seeing it edgewise we saw in face, its natural curvature would strike all eyes.—*Popular Science Review.*

* Read before the Academy of Sciences of Paris, July 11, 1881.

VALUABLE RECIPES.

QUICK PROCESS FOR MAKING VINEGAR.—What is known as the German process is the most rapid method of making a good vinegar. In this, dilute alcoholic liquor to which one one-thousandth part of honey or extract of malt has been added is caused to trickle down through a mass of beechwood shavings previously steeped in vinegar and contained in a vessel called a vinegar generator (*Essigbilder*). It may consist of a large oak hogshead or barrel furnished with a loose lid or cover, a few inches below which is fitted a perforated shelf, having a number of small holes loosely filled with packthread about six inches long, knotted at the upper end to prevent their falling through. Several small glass tubes, long enough to project slightly above and below the shelf, are also fitted as perforations in the shelf to serve as air vents. The vessel at the lower part is pierced with eight or ten holes equally distributed around the sides at about six inches above the bottom, to admit of the entrance of air. A small siphon tube, the upper curve of which is an inch below the air holes, serves to carry off the liquid as fast as it accumulates at the bottom. The alcoholic liquid at a temperature of 75°—83° Fah., is run in on the shelf, and slowly trickles down through the holes by means of the packthread, diffuses itself over the shavings, slowly collects at the bottom, and runs off by the siphon exit. The air enters by the lower holes, passes freely through the shavings, and escapes by the glass tubes. The temperature within the apparatus soon rises to about 100° Fah., and remains stationary at this point while the action goes on favorably. The liquid generally requires to be passed three or four times through the cask before its acetification is complete.

TO BLEACH GUTTA PERCHA.—Dissolve the gutta percha in twenty times its weight of boiling benzole, add to the solution plaster of very good quality, and agitate the mixture from time to time. By reposing for two days the plaster is deposited and carries down with it all the impurities of the gutta percha insoluble in benzole. The clear liquid decanted is introduced by small portions at a time into twice its volume of alcohol of 90 per cent., agitating continually. During this operation the gutta percha is precipitated in the state of a pasty mass, perfectly white. The desiccation of the gutta percha thus purified requires several weeks' exposure to the air, but may be accelerated by trituration in a mortar, which liberate moistures which it tends to retain.

ETCHING ON GLASS.—Heat the glass and coat it with an even film of beeswax or paraffine. Through this to the surface of the glass etch the characters or design with a sharp point or graver. Put into a shallow lead tray a quantity of fluoride of calcium (fluorspar) in fine powder, mix it into a thin paste with strong oil of vitriol, and set the tray on a warm sand bath. Place the glass tightly over the tray so that the hydrofluoric acid (gas) may come into contact with the prepared surface. In ten minutes the parts of the glass not covered with wax or paraffine will be properly etched. The etched lines will be translucent—if it is desired to make the etching opaque (white), the plate should be wet before exposing it. A little benzole will remove the wax or paraffine.

BATTERY CARBON.—A useful method of preparing cheap carbon poles for voltaic batteries has been devised by M. Mauri. It consists in taking finely powdered graphite mixed with an equal weight of sulphur free from carbonate, and heating the mixture in a crucible until all the sulphur is fused. The temperature, however, should not be raised over 200° Cent. When the mass is fluid it is poured into a suitable mould of metal and a stout copper wire is inserted to serve for an electrode. When the mass is cool and solid it is ready for use. Its conductivity is practically as good as that of the best retort carbon, and as it is more electro-negative than simple carbon, the electromotive force of the cell is higher. By increasing the proportion of sulphur in the mixture a highly resisting composition may be obtained which can take the place of copper or platinum silver coils for telegraphic or electric lighting purposes.

COURT PLASTER.—Soak isinglass in a little warm water for seventy-four hours, then evaporate nearly all the water by gentle heat, dissolve the residue in a little proof spirits of wine, and strain the whole through a piece of open linen. The strained mass should be a stiff jelly when cool. Now stretch a piece of silk or sarsanet on a wooden frame, and fix it tight with tacks or packthread. Melt the jelly, and apply it to the silk thinly and evenly with a badger hair brush. A second coating must be applied when the first has dried. When both are dry, apply over the whole surface two or three coatings of balsam of Peru. Plaster thus made is said to be very pliable and never breaks.

GLAZE FOR POTTERY.—1. Make a saturated solution of sugar of lead (lead acetate) in hot water. Dip the pipes in this, or apply it with a brush to the outside, then dry and expose in an open muffle at a low red heat until properly glazed. 2. Potassium carbonate, 1 part; borax, 5 parts; melt together in a sand crucible and pour out on an iron plate to cool, then powder and mix into a paste with a little turpentine oil for use. Apply with a brush or clean rag, and heat slowly in a muffle or oven to incipient redness.

OXYGEN, TO MAKE—Mix pure crystallized potassium chlorate with about one-quarter its weight of pure black oxide of manganese, and heat the mixture in a copper retort, with large delivery tube, until the gas begins to come over. Conduct the gas through a large empty bottle (to avoid accident by back pressure), then through a strong solution of iron sulphate (copperas), and then through an iron tube several feet in length, filled loosely with fresh quicklime in granular lumps (free from dust). Collect in a rubber bag. An ordinary mouthpiece answers well enough if the air from the lungs is expelled through the nostrils, or so as not to contaminate the contents of the bag. The heat should be continued under the retort with caution to avoid too rapid a disengagement of the oxygen until no more gas comes over.

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